The James H. Hilton Coliseum, completed in 1971, provides accommodations for approximately 14,000 persons in individual upholstered seats for student convocations, arena-type entertainment, graduation ceremonies, indoor athletic events and other events requiring extensive indoor space. It is the second building of the Iowa State Center, which is being constructed as a focal point for many of the University's cultural, recreational and continuing education activities. First building was the C.Y. Stephens Auditorium, opened in 1969 as a magnificent theater and music hall, seating 2,700. Completion of a 450-seat Little Theater is scheduled for 1973. The fourth structure, scheduled for construction in the near future, is to be a continuing education building to house the many conferences, seminars, meetings and short courses held on campus each year.
William Robert Parks
President
Iowa State University
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Administration of
Iowa State University

The laws of the United States and of the State of Iowa provide for resident academic instruction, research, and extension education, and for the management of Iowa State University of Science and Technology. The University and two other state educational institutions of higher learning are governed by the State Board of Regents, composed of nine members nominated by the Governor of Iowa and confirmed by the Senate of Iowa. The immediate regulation and direction of the academic, research, and extension activities of the University are delegated by the Board of Regents to the president and faculty of the University. The Board appoints an executive secretary with over-all responsibility for the administration of the central office of the Board, located in Des Moines.

STATE BOARD OF REGENTS

Stanley F. Redeker, President

R. Wayne Richey, Executive Secretary

MEMBERS OF THE BOARD

Terms expire June 30, 1971

Casey Loss ........................................... Algona
Thomas A. Louden .................................. Fairfield
William B. Quarton ................................. Cedar Rapids

Terms expire June 30, 1973

Ned E. Perrin .................................. Mapleton
Stanley F. Redeker ................................. Boone
Ralph H. Wallace ................................. Mason City

Terms expire June 30, 1975

Ray V. Bailey .................................. Clarion
Mrs. H. Rand Petersen ................................. Harlan
Donald H. Shaw ................................. Davenport
OFFICERS OF ADMINISTRATION

William Robert Parks, Ph.D.
President of the University

James H. Hilton, D.Sc.
President Emeritus

George C. Christensen, Ph.D.
Vice President for Academic Affairs

Carl Hamilton, B.S.
Vice President for Information and Development

William L. Layton, Ph.D.
Vice President for Student Affairs

Wayne R. Moore, B.S.
Vice President for Business and Finance

Kenneth J. Frey, Ph.D.
Acting Vice President for Research

Acting Dean of the Graduate College

Instruction and Research

Floyd Andre, Ph.D.
Dean of the College of Agriculture
Director of the Agriculture and Home Economics Experiment Station

Virgil S. Lagomarcino, Ph.D.
Director of Teacher Education
Dean of the College of Education

David R. Boylan, Ph.D.
Dean of the College of Engineering
Director of the Engineering Research Institute

Helen LeB. Hilton, Ph.D.
Dean of the College of Home Economics
Director of Home Economics Research Institute

Chalmer J. Roy, Ph.D.
Dean of the College of Sciences and Humanities
Director of the Sciences and Humanities Research Institute

Ralph L. Kitchell, Ph.D.
Dean of the College of Veterinary Medicine
Director of the Veterinary Medical Research Institute

Robert S. Hansen, Ph.D.
Director of the Institute for Atomic Research

Theodore A. Bancroft, Ph.D.
Director of the Statistical Laboratory

Clair G. Maple, Ph.D.
Director of the Computation Center

Services

Arthur M. Gowan, Ph.D.
Dean of Admissions and Records

Marvin A. Anderson, Ph.D.
Dean of University Extension

C. Arthur Sandeen, Ph.D.
Dean of Students

Charles F. Frederiksen, M.S.
Director of Residence

Gail Proffitt, M.D.
Director of the Student Health Service

Warren B. Kuhn, M.L.S.
Director of the University Library

Bernard O. Randol, B.B.A., C.P.A.
Controller and Secretary

Warren R. Madden, M.B.A.
Assistant Vice President for Business and Finance

Samuel A. McDowell
Treasurer

Delbert H. Ostermann
Director of Purchasing and Stores

Edgar P. Swanson, M.S.
Supervisor of Student Loans and Scholarships

William W. Whitman, B.S.
Director of Physical Plant

Jess N. Cole, B.S.
Personnel Officer
Iowa State University of Science and Technology is located at Ames, just west of the geographic center of Iowa. Ames has a population of approximately 40,000 including University students.

As a result of Iowa State's vital contributions to the first large-scale release of atomic energy, the United States Atomic Energy Commission located a major research center at the University. The Iowa Highway Commission was first established at Iowa State, and kept its headquarters in Ames when it became a separate entity. Another important University-related agency, the United States Department of Agriculture's National Animal Disease Laboratory, was brought to Ames in 1956.

Covering 1,000 acres of gently rolling prairie in the northwest sector of Ames, the University campus has been carefully developed to provide a pleasant, naturalistic setting for conveniently located facilities. There are additional University facilities including farms and research areas near Ames and at strategic locations throughout the state.

Acquisition value of the Iowa State physical plant in 1970 was in excess of $159 million, including $130 million owned by the University and the rest by affiliated organizations. The University's anticipated expenditure in 1970-71 was approximately $87.2 million, of which state appropriations provided about 37 percent. The remainder came from fees, contracts, sales, private gifts and grants, federal funds, and endowment.
University Calendar/1971-1973

FALL QUARTER 1971

Sept. 1-5, Wednesday, 8 a.m. to Sunday
Sept. 1-2, Wednesday and Thursday, 8 a.m.-4:30 p.m.
Sept. 3, Friday, 1-5 p.m.

Sept. 6, Monday
Sept. 7, Tuesday
Sept. 10, Friday, 4 p.m.
Sept. 16, Thursday, 4-6 p.m.
Sept. 27, Monday

Oct. 8, Friday
Oct. 8, Friday
Oct. 22-25, Friday p.m. to Monday noon
Nov. 2, Tuesday

Nov. 17, Wednesday
Nov. 23, Tuesday
Nov. 24, Wednesday
Nov. 25-26, Thursday, Friday

Program for new students who did not attend summer orientation.
Registration
Examinations to secure advanced standing or to remove incompletes
University holiday, offices closed
Class work begins
End of fee payment period
English proficiency examination
Last day a student may drop a course without recommendation of instructor
Mid-quarter reports due
Final date for filing diploma cards
Homecoming, classes dismissed at 12 noon Friday, resume 12:10 p.m. Monday
Last day a student may drop a course without extenuating circumstances
Examinations begin
Examinations end
Graduation
University holidays, offices closed

<table>
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<tr>
<th>SEPTEMBER</th>
<th>OCTOBER</th>
<th>NOVEMBER</th>
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<td>2 3 4 5 6 7 8</td>
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<th>WINTER QUARTER 1972</th>
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<tr>
<td>Nov. 30, Tuesday</td>
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<td>Nov. 30, Tuesday*</td>
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<tr>
<td>Dec. 1, Wednesday</td>
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<td>Dec. 3, Friday, 4 p.m.</td>
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<td>Dec. 9, Thursday, 4-6 p.m.</td>
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<td>Dec. 21, Tuesday</td>
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<td>Dec. 21, Tuesday, 6 p.m.</td>
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<td>Dec. 23-24, Thursday-Friday</td>
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<td>Dec. 31, Friday</td>
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<td>Jan. 3, Monday, 7 a.m.</td>
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<td>Jan. 14, Friday</td>
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<td>Jan. 14, Friday</td>
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<tr>
<td>Feb. 4, Friday</td>
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<td>Feb. 21, Monday</td>
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<td>Feb. 25, Friday</td>
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<td>Feb. 26, Saturday</td>
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</table>

Examinations to secure advanced standing or to remove incompletes
Registration
Class work begins
End of fee payment period
English proficiency examination
Last day a student may drop a course without recommendation of instructor
Christmas recess begins
University holidays, offices closed
University holiday, offices closed
Class work resumes
Mid-quarter reports due
Final date for filing diploma cards
Last day a student may drop a course without extenuating circumstances
Examinations begin
Examinations end
Graduation

*Students in residence preceding quarter will register during the examination week of that quarter.
## SPRING QUARTER 1972

| March 3, Friday | Examinations to secure advanced standing or to remove incompletes |
| March 3, Friday* | Registration |
| March 6, Monday | Class work begins |
| March 8, Wednesday, 4 p.m. | End of fee payment period |
| March 16, Thursday, 4-6 p.m. | English proficiency examination |
| March 24, Friday | Last day a student may drop a course without recommendation of instructor |
| March 30, Thursday, 6 p.m. | Easter recess begins |
| April 4, Thursday, 7 a.m. | Class work resumes |
| April 7, Friday | Mid-quarter reports due |
| April 7, Friday | Final date for filing diploma cards |
| May 4-6, Thursday, Saturday (tentative) | Vislesha, classes dismissed 12 noon Thursday |
| May 5, Friday | Last day a student may drop a course without extenuating circumstances |
| May 22, Monday | Examinations begin |
| May 26, Friday | Examinations end |
| May 27, Saturday | Graduation |
| May 29, Monday | University holiday, offices closed |

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<tr>
<th>MARCH</th>
<th>APRIL</th>
<th>MAY</th>
<th>JUNE</th>
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<th>AUGUST</th>
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<td>1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31</td>
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<td>5 6 7 8 9 10 11</td>
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<td>11 12 13 14 15 16 17</td>
<td>9 10 11 12 13 14 15</td>
<td>13 14 15 16 17 18 19</td>
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</table>

## SUMMER QUARTER 1972

| June 5, Monday | Registration |
| June 6, Tuesday | Class work begins |
| June 7, Wednesday, 4 p.m. | End of fee payment period |
| June 15, Thursday, 4 p.m. | English proficiency examination |
| July 4, Tuesday | University holiday, offices closed |
| July 11, Tuesday | First session ends |
| July 11, Tuesday | Registration |
| July 12, Wednesday | Class work begins |
| July 13, Thursday, 4 p.m. | End of fee payment period |
| July 20, Thursday, 4 p.m. | English proficiency examination |
| Aug. 15, Tuesday | Second session ends |
| Aug. 16, Wednesday | Graduation |

*Students in residence preceding quarter will register during the examination week of that quarter.
FALL QUARTER 1972

Sept. 1-5, Friday, 8:00 a.m. through Tuesday
Sept. 1, Friday, 8:00-4:30 p.m.
Sept. 4, Monday
Sept. 5, Tuesday, 1:00-5:00 p.m.

Program for new students who did not attend summer orientation.

Sept. 6, Wednesday
Sept. 8, Friday, 4:00 p.m.
Sept. 14, Thursday, 4:00-6:00 p.m.
Sept. 26, Tuesday

Class work begins
End of fee payment period
English qualifying examination
Last day a course may be dropped without recommendation of instructor

Oct. 13, Friday
Oct. 13, Friday
Oct. 31, Tuesday

Mid-quarter reports due
Final date for indicating intent to graduate
Last day a course may be dropped without extenuating circumstances

Nov. 3-6, Friday p.m. to Monday a.m.
Nov. 15, Wednesday
Nov. 21, Tuesday
Nov. 22, Wednesday
Nov. 23, 24, Thursday and Friday

Homecoming, classes dismissed at 12 noon Friday, resume 12:10 p.m. Monday
Examinations begin
Examinations end
Graduation
University holidays, offices closed

WINTER QUARTER 1973

Nov. 28, Tuesday

Examinations to secure advance standing or to remove incompletes
Registration
Class work begins
End of fee payment period
English qualifying examination
Last day a course may be dropped without recommendation of instructor

Dec. 1, Friday, 4:00 p.m.
Dec. 7, Thursday, 4:00-6:00 p.m.
Dec. 19, Tuesday
Dec. 22, Friday, 6:00 p.m.
Dec. 25, 26, Monday and Tuesday
Jan. 1, Monday
Jan. 3, Wednesday, 7:00 a.m.
Jan. 12, Friday
Jan. 12, Friday
Feb. 2, Friday
Feb. 19, Monday
Feb. 23, Friday
Feb. 24, Saturday

Christmas recess begins
University holidays, offices closed
University holiday, offices closed
Class work resumes
Mid-quarter reports due
Final date for indicating intent to graduate
Last day a course may be dropped without extenuating circumstances
Examinations begin
Examinations end
Graduation

*Students in residence preceding quarter will register during the examination week of that quarter.
## SPRING QUARTER 1973

<table>
<thead>
<tr>
<th>March</th>
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<th>March 2, Friday</th>
<th>Examinations to secure advance standing or to remove incompletes</th>
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<tr>
<td>March 2, Friday*</td>
<td></td>
<td>Registration</td>
<td>Class work begins</td>
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<tr>
<td>March 5, Monday</td>
<td></td>
<td>End of fee payment period</td>
<td>English proficiency examination</td>
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<tr>
<td>March 7, Wednesday, 4:00 p.m.</td>
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<td>Last day a course may be dropped without recommendation of instructor</td>
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<tr>
<td>March 16, Thursday, 4:00-6:00 p.m.</td>
<td></td>
<td>Mid-quarter reports due</td>
<td>Easter recess begins</td>
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<tr>
<td>March 23, Friday</td>
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<td>Final date for filing diploma cards</td>
<td>Class work resumes</td>
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<tr>
<td>April 13, Friday</td>
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<td>Easter recess begins</td>
<td>Mid-quarter reports due</td>
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<td>April 13, Friday</td>
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<td>Class work resumes</td>
<td>Examinations begin</td>
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<td>April 19, Thursday, 6:00 p.m.</td>
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<td>Veishea, classes dismissed 12 noon Thursday</td>
<td>Examinations end</td>
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<td>April 24, Tuesday, 7:00 a.m.</td>
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<td>Examinations begin</td>
<td>Graduation</td>
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<td>May 3-5, Thursday-Saturday (tentative)</td>
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<td>Last day a course may be dropped without extenuating circumstances</td>
<td>Graduation</td>
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<td>May 4, Friday</td>
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<td>Last day a course may be dropped without extenuating circumstances</td>
<td>Graduation</td>
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<td>May 21, Monday</td>
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<td>Examinations begin</td>
<td>Last day a course may be dropped without recommendation of instructor (1st session)</td>
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<td>May 25, Friday</td>
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<td>Examinations end</td>
<td>Last day a course may be dropped without recommendation of instructor (1st session)</td>
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<tr>
<td>May 26, Saturday</td>
<td></td>
<td>Graduation</td>
<td>Last day a course may be dropped without recommendation of instructor (2nd session)</td>
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<tr>
<td>May 28, Monday</td>
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<td>University holiday, offices closed</td>
<td>Last day a course may be dropped without recommendation of instructor (2nd session)</td>
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### Calendar

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<tr>
<th>March</th>
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</table>

## SUMMER QUARTER 1973

| June    |                      | Registration    | Class work begins                                                |
|---------|----------------------|End of fee payment period | Class work begins                                                |
| June 4, Monday* |                      | Last day a course may be dropped without recommendation of instructor (1st session) | Last day a course may be dropped without extenuating circumstances (1st session) |
| June 5, Tuesday  |                      | English qualifying examination | Last day a course may be dropped without extenuating circumstances (1st session) |
| June 6, Wednesday, 4:00 p.m. |              | University holiday, offices closed | Last day a course may be dropped without recommendation of instructor (2nd session) |
| June 14, Thursday  |                      | First session ends | Last day a course may be dropped without recommendation of instructor (2nd session) |
| June 14, Thursday  |                      | Registration for second summer session | Last day a course may be dropped without recommendation of instructor (2nd session) |
| June 28, Thursday  |                      | Class work begins | Last day a course may be dropped without recommendation of instructor (2nd session) |
| July 4, Wednesday  |                      | End of fee payment period | Last day a course may be dropped without recommendation of instructor (2nd session) |
| July 10, Tuesday   |                      | English qualifying examination | Last day a course may be dropped without recommendation of instructor (2nd session) |
| July 11, Wednesday  |                      | University holiday, offices closed | Last day a course may be dropped without recommendation of instructor (2nd session) |
| July 12, Thursday   |                      | First session ends | Last day a course may be dropped without recommendation of instructor (2nd session) |
| July 13, Friday, 4:00 p.m. |              | Registration for second summer session | Last day a course may be dropped without recommendation of instructor (2nd session) |
| July 19, Thursday, 4:00 p.m. |              | Last day a course may be dropped without recommendation of instructor (2nd session) | Last day a course may be dropped without recommendation of instructor (2nd session) |
| July 20, Friday     |                      | Last day a course may be dropped without recommendation of instructor (2nd session) | Last day a course may be dropped without recommendation of instructor (2nd session) |
| Aug. 3, Friday      |                      | Last day a course may be dropped without recommendation of instructor (2nd session) | Last day a course may be dropped without recommendation of instructor (2nd session) |
| Aug. 15, Wednesday   |                      | Last day a course may be dropped without recommendation of instructor (2nd session) | Last day a course may be dropped without recommendation of instructor (2nd session) |
| Aug. 16, Thursday    |                      | Last day a course may be dropped without recommendation of instructor (2nd session) | Last day a course may be dropped without recommendation of instructor (2nd session) |

*Students in residence preceding quarter will register during the examination week of that quarter.
The Faculty

The General Faculty consists of the President, Vice Presidents, Deans, Director of the Library, all professors and associate professors, and such other members of the University staff as the President may designate.

PARKS, W. ROBERT, President; Professor of Political Science

ABALU, GEORGE O., Instructor in Economics
B.S., 1969, Wisconsin State (Platteville); M.S., 1970, Iowa State

ABIAN, ALEXANDER, Professor of Mathematics
B.S., 1946, Tehran (Iran); M.S., 1954, Chicago; Ph.D., 1956, Cincinnati

ABRAMS, NORMAN R., Assistant Professor of Applied Art

ADAMANTIADES, ACHILLES G., Assistant Professor of Nuclear Engineering
Diploma, 1957, Technical University of Athens (Greece); Ph.D., 1966, Massachusetts Institute of Technology

ADAMS, HARRIET, Professor of Applied Art
B.Des., 1930, Kansas; M.A., 1934, Western Reserve

AGRAWAL, BINOD C., Assistant Professor of Anthropology

AHRENS, FRANKLIN A., Associate Professor of Veterinary Physiology and Pharmacology
B.S., D.V.M., 1959, Kansas State; M.S., 1965, Ph.D., 1968, Cornell

AIKMAN, JOHN M., Professor of Botany
A.B., 1917, A.M., 1921, D.Sc., 1961, Nebraska Wesleyan; Ph.D., 1928, Nebraska

AITCHISON, GARY L., Assistant Professor of Industrial Administration
B.A., 1956, State College of Iowa; M.A., 1961, Colorado State

ALEXANDER, JACK M., Assistant Professor; Farm Manager
B.S., 1950, M.S., 1960, Iowa State

ALLEN, EDWARD S., Professor of Mathematics
A.B., 1909, A.M., 1910, Ph.D., 1914, Harvard

ALLEN, PHILIP M., Assistant Professor of Applied Art

ALMFIELDT, MAURICE W., Professor of Engineering Graphics
B.S., 1932, Rhode Island State

ALMQVIST, JAMES C., Assistant Professor; Area Director, University Extension
B.S., 1954, M.S., 1962, Iowa State

AMEMIYA, MINORU, Associate Professor of Agronomy
B.S., 1942, California; M.S., 1948, Ph.D., 1950, Ohio State

ANDERSON, CAROL L., Assistant Professor of Child Development
B.S., 1961, M.S., 1969, Wisconsin

ANDERSON, DALE A., Associate Professor of Aerospace Engineering
B.S., 1957, St. Louis; M.S., 1959, Ph.D., 1964, Iowa State

ANDERSON, DALE L., Instructor in Physical Education for Men
B.A., 1958, Luther; M.A., 1970, Iowa

ANDERSON, DON M., Professor of Foreign Languages
ANDERSON, ERNEST W., Professor of Aerospace Engineering and Head of the Department; Anson Marston Distinguished Professor in Engineering
B.S., 1926, North Dakota State; M.S., 1928, Ph.D., 1933, Iowa State

ANDERSON, GLENDON R., Assistant Professor of Physical Education for Men; Head Basketball Coach
B.S., 1951, Colorado State

ANDERSON, IRVIN C., Professor of Agronomy; Professor of Botany
B.S., 1951, Iowa State; M.S., 1954, Ph.D., 1957, North Carolina State

ANDERSON, JULIA F., Professor, Associate Dean of the College of Home Economics
B.S., 1941, Iowa State; M.S., 1947, Washington

ANDERSON, LESLIE A., Instructor in Physical Education for Men
B.S., 1960, M.S., 1968, Iowa State

ANDERSON, LLOYD L., Associate Professor of Animal Science
B.S., 1957, Ph.D., 1961, Iowa State

ANDERSON, RUSSELL D., Instructor in Electrical Engineering
B.S., 1949, M.S., 1958, Ph.D., 1961, Iowa State

ANDRONIKOU, ANASTASIOS M., Instructor in Mathematics
B.S., 1967, Athens (Greece)

ANGELICI, ROBERT J., Associate Professor of Chemistry
B.S., 1959, St. Olaf; Ph.D., 1962, Northwestern

ANKER, DONALD E., Assistant Professor of Electronics Technology
B.S., 1962, Iowa State

APPLEQUIST, JON B., Professor of Biophysics
B.S., 1954, California (Berkeley); Ph.D., 1959, Harvard

APT, LEON J., Associate Professor of History

ARENDT, STEVEN M., Lt., USN, Assistant Professor of Naval Science
B.S., 1966, U.S. Naval Academy

ARGANBRIGHT, DEANE E., Assistant Professor of Mathematics

ARMBRECHT, MARLENE, Instructor in Child Development
B.S., 1966, M.S., 1970, Iowa State

ARNBOL, CARL A., Associate Professor of Engineering Graphics
B.M.E., 1946, Minnesota; M.S., 1955, Kansas State; M.S., 1965, Iowa State

ARNOLD, BARRY C., Associate Professor of Mathematics; Associate Professor of Statistics
B.Sc., 1961, McMaster; M.S., 1963, Ph.D., 1965, Stanford

ARNOLD, CAROLE R., Assistant Professor of Psychology

ARNOLD, LIONEL K., Professor of Chemical Engineering
A.B., 1920, Ellsworth; B.S., 1921, M.S., 1926, Ph.D., 1930, Iowa State

ARNOLD, TOM A., Instructor; Head, Circulation Department, Library
B.S., 1959, Florida State; M.L.S., 1968, Oklahoma

ARNRICHT, LOTTE, Professor of Food and Nutrition
B.S., 1944, Ph.D., 1952, California

ARTHUR, I.W., Professor of Economics
B.S., 1916, M.S., 1927, Iowa State; Ph.D., 1939, Minnesota

ATHERLY, ALAN G., Assistant Professor of Genetics; Assistant Professor of Biochemistry
B.S., 1960, Western Michigan; Ph.D., 1965, North Carolina

ATKINS, RICHARD E., Professor of Agronomy
B.S., 1941, Kansas State; M.S., 1942, Ph.D., 1948, Iowa State
AUGUSTINE, GRACE M., Professor Emeritus of Institution Management  
B.S., 1929, M.A., 1930, Ph.D., 1935, Columbia  

AVANT, LLOYD L., Associate Professor of Psychology  

AVEY, JAMES A., Associate; Editor, Midwest Plan Service  
B.S., 1962, Iowa State  

AVEZZANO, JOSEPH W., Instructor in Physical Education for Men  
B.S., 1965, Florida State  

AVRAAMIDES, ARCHILLES, Instructor in History  

AYRES, GEORGE E., Instructor, Associate, Agricultural Engineering  
B.S., 1964, Cornell; M.S., 1966, Iowa State  

BAILEY, CHARLES R., Capt., USA, Assistant Professor of Military Science  
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Vivah M. Jennings, Extension Crop Production Specialist
Leslie G. Kral, Extension Farm Management Specialist
Norril A. Rogness, Industrial Specialist, CIRAS
Charlotte S. Young, Extension Consumer and Management Specialist

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William R. Meigs, Director
*Elizabeth W. Harrison, Home Economist

CEDAR COUNTY, Tipton
Kenneth D. Muller, Director

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Donald H. Goering, Director
*Charlotte I. Smith, Assistant

JOHNSON COUNTY, Iowa City
Clair E. Hein, Director
*Martha B. Passmore, Home Economist

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Joe E. Legg, Director
*Varlyn D. Fink, 4-H and Youth Leader

LINN COUNTY, Cedar Rapids
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Grace Drenkhahn, Home Economist
Thomas K. McCormick, 4-H and Youth Leader
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*Dorothy T. Keith, Home Economist

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POTTAWATTAMIE COUNTY, WEST, Council Bluffs
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Dale M. Studt, Extension Crop Production Specialist
CERRO GORDO COUNTY, Mason City
  Spencer G. Williams, Director
  Phyllis H. Seymour, Home Economist
  Marcia M. McArthur, 4-H and Youth Leader
FLOYD COUNTY, Charles City
  Robert P. McCrackin, Director
  *Nancy J. Severtson, Home Economist
FRANKLIN COUNTY, Hampton
  Alvin M. Andersen, Director
  Sylvia L. Lehman, Assistant
HANCOCK COUNTY, Garner
  Carl M. Little, Director
  *Elsie Mae Van Wert, Home Economist
  *K. Keith Kimberlin, 4-H and Youth Leader
MITCHELL COUNTY, Osage
  Edgar W. Dorow, Director
  *May Johnson, 4-H and Youth Leader
WINNEBAGO COUNTY, Thompson
  Richard W. Anderson, Director
WORTH COUNTY, Northwood
  Gene R. McBride, Director
  *Florence Ferden, Home Economist

OTTUMWA AREA
William E. Linstrom, Area Extension Director
James R. Ahrenholz, Extension Management Specialist
Harold L. Craig, Extension 4-H and Youth Leader
Clifford I. Iverson, Extension Livestock Production Specialist
Allan L. Seim, Extension Crop Production Specialist
APPANOOSE COUNTY, Centerville
  Harold D. Holder, Director
  *Inga O. Eddy, Home Economist
DAVIS COUNTY, Bloomfield
  William D. Byers, Director
  *Esther L. Hubbard, Home Economist
JEFFERSON COUNTY, Fairfield
  Stanley R. Stover, Director
KEOKUK COUNTY, Sigourney
  Donald A. Shirk, Director
  *Adelena S. Clark, Home Economist

LUCAS COUNTY, Charlton
  Joe D. Miller, Director
MAHASKA COUNTY, Oskaloosa
  Donald P. Arendt, Director
  *John W. Patterson, 4-H and Youth Leader
MARION COUNTY, Knoxville
  George F. Peisen, Director
  *Ruth S. Archibald, Home Economist
MONROE COUNTY, Albia
  Richard R. Johnson, Director
VAN BUREN COUNTY, Keosauqua
  Melvin J. Powers, Director
  *Edna C. Morris, Home Economist
WAPELLO COUNTY, Ottumwa
  Dale M. Uehling, Director
  Joan C. Kinney, Home Economist
  Mary A. Patterson, Home Economist
WAYNE COUNTY, Corydon
  F. Wayne Hart, Director

SIOUX CITY AREA
Roger D. Iverson, Area Extension Director
Galen R. DeVauls, Extension Consumer and Management Specialist
Earl D. Mobley, Extension Livestock Production Specialist
Kyle R. Peterson, Jr., Extension Crop Production Specialist
Larry D. Trede, Extension Farm Management Specialist
CHEROKEE COUNTY, Cherokee
  Forrest J. Kohrt, Director
  *Theda N. Scott, Home Economist
  Vernon E. Rath, Assistant
CRAWFORD COUNTY, Denison
  Maclyn E. LaRue, Director
  *Norma L. Morgan, Home Economist
  Clarence J. Kortman, Assistant
IDA COUNTY, Ida Grove
  David L. Hessman, Director
MONONA COUNTY, Onawa
  Larry D. DuVal, Director
  *Lettie B. Thrift, Home Economist
PLYMOUTH COUNTY, LeMars
  Lyle R. Mackey, Director
  Ardyce F. Roehr, 4-H and Youth Leader
SAC COUNTY, Sac City
Kenneth R. Littlefield, Director
H. Elizabeth Block, Home Economist
*Floyd Schnirring, 4-H and Youth Leader

WOODBURY COUNTY, Sioux City
Bruce W. Marcue, Director
Mary M. Cable, Home Economist
Ronald G. Karnatz, Assistant
*Kathleen F. Schmit, Assistant
Sharon M. Wedberg, Assistant

SPENCER AREA

W. John Johnson, Jr., Area Extension Director
Dean L. Barnes, Extension Crop Production Specialist
Louie O. Hansen, Extension Resource Development Specialist
Linferd C. McGrane, Industrial Specialist, CIRAS
William J. Turner, Extension Farm Management Specialist

BUENA VISTA COUNTY, Storm Lake
James D. Nuss, Director
*Gary W. Anderson, 4-H and Youth Leader

CLAY COUNTY, Spencer
R. Paul Trinkle, Director
*Lola A. Robinson, Home Economist

DICKINSON COUNTY, Spirit Lake
James A. Yungclas, Jr., Director
*Richard N. Haack, 4-H and Youth Leader

EMMET COUNTY, Estherville
Gene Rullestad, Director
*June C. Steinborn, Home Economist

KOSSUTH COUNTY, Algona
John J. Ley, Director
*Ruth O. Patterson, 4-H and Youth Leader

LYON COUNTY, Rock Rapids
Roger A. Baldwin, Director
*Eleanor L. Ladd, Home Economist

O’BRIEN COUNTY, Primghar
John H. Longstreet, Director
*Ethel N. Oldaker, Home Economist

OSCEOLA COUNTY, Sibley
Loren J. Bell, Director

PALO ALTO COUNTY, Emmetsburg
Harold H. Heykes, Director
*Margaret D. Pratt, Home Economist

SIoux COUNTY, Orange City
Maurice E. Eldridge, Director
*Gary L. Bredensteiner, 4-H and Youth Leader

WATERLOO AREA

Alvin T. Goetsch, Area Extension Director
Kay A. Connelly, Extension Crop Production Specialist
Eldon J. Hans, Extension Livestock Production Specialist
Philip P. Hufferd, Extension Farm Management Specialist

BLACK HAWK COUNTY, Waterloo
William D. Davidson, Director
Ruth C. Murphy, Home Economist
Robert D. Engle, 4-H and Youth Leader
George J. Oster, Assistant

BREMER COUNTY, Tripoli
Dale G. Shires, Director

BUCHANAN COUNTY, Independence
Jay I. Partridge, Director

BUTLER COUNTY, Allison
Larry E. Loenser, Director

CHICKASAW COUNTY, New Hampton
Gerald K. Anderson, Director
*Marilyn M. Kirchner, Home Economist

GRUNDY COUNTY, Grundy Center
Everett D. Halstead, Director
*Genevieve Craven, Home Economist
*Harold E. Wagner, 4-H and Youth Leader

TAMA COUNTY, Toledo
G. Gress Rogers, Director
Mina S. Olin, Home Economist

*Has multi-county responsibility
HEADQUARTERS STAFF
Waldo Wegner, Director
Lloyd E. Anderson, Industrial Specialist
William R. Berkland, Assistant Extension Editor, CIRAS and Engineering Extension
Robert B. Boyd, Industrial Specialist
Donald I. McKeown, Technical Director, Professional Development Service Center
Lynn D. Richardson, Industrial Specialist
Edward O. Sealine, Industrial Specialist
Robert W. Shearer, Industrial Specialist
Blaine F. Vandeventer, Staff Engineer
John H. Wessman, Industrial Specialist

FIELD STAFF
Dwayne D. Dygert, Industrial Specialist, Creston and Council Bluffs Areas
James W. Klemme, Industrial Specialist, Mason City, Dubuque and Waterloo Areas
Robert A. Lyon, Industrial Specialist, Davenport Area
Linferd C. McGrane, Industrial Specialist, Spencer, Sioux City and Fort Dodge Areas
Norril A. Rogness, Industrial Specialist, Cedar Rapids and Ottumwa Areas
James M. Schaaf, Industrial Specialist, Des Moines Area
The University

Iowa State University was one of the earliest institutions established in the movement to create an educational system uniquely suited to American democratic philosophy.

It was chartered by the Iowa General Assembly in 1858. Four years later the national "people's college" movement was underwritten by the Morrill Land-Grant Act. The act made federal lands available for sale to endow colleges whose aim was to promote "liberal and practical education...in the several pursuits and professions of life."

Originally these colleges were primarily concerned with subjects relating to agricultural and industrial pursuits. Thus this institution was chartered as the "Iowa Agricultural College," and in 1896 was given the more inclusive name, "Iowa State College of Agriculture and Mechanic Arts." In those beginning years it established a national—and in many cases international—reputation in the areas of agriculture, veterinary medicine, home economics, and engineering.

Adapting land-grant philosophy to the changing needs of the twentieth century, Iowa State has maintained its preeminence in these areas, but has broadened and strengthened its work in other areas, to the point that its largest enrollment now is in the sciences and humanities.

Increasing numbers of students find in the broad-based curriculum of Iowa State opportunities to specialize in excellent programs of science and technology, and to acquire a broad general background of education in the "liberal arts" tradition.

THE DEVELOPMENT OF THE UNIVERSITY

Iowa was the first state to accept the terms of the Morrill Land-Grant Act. In March, 1863, the General Assembly awarded Iowa's grant to the recently chartered institution at Ames. The school opened its doors to a preparatory class in the fall of 1868. Instruction at the college level began the following March. A class of 26 was graduated at the first commencement in 1872. In the 12 months ending July 1, 1970, there were 3,803 baccalaureate or advanced degrees awarded, plus 154 certificates for special programs.

Iowa State pioneered in the establishment of agricultural curricula, was the first state institution to found a veterinary school, and helped move engineering from a small and narrow
profession to its present key position in our industrialized society. The basic sciences were emphasized. Coeducational from its beginning, Iowa State took leadership in domestic economy (later to become home economics).

Graduate study was offered almost as soon as classes began, and the first graduate degree was conferred in 1877. Experimentation and research also started early, first in agriculture and shortly thereafter in home economics, engineering, science, and veterinary medicine.

Iowa State shared the conviction with other land-grant institutions that all people should have access to the ideas and knowledge of the campus. By 1870 it was holding educational institutes in various Iowa towns. In 1903 Iowa State set the pattern of county cooperative extension as it is conducted now throughout the United States.

Iowa State’s program became that of a university with special teaching responsibility in science and technology, an extension education program throughout the state, and extensive research interests to advance the frontiers of learning.

Since 1959 it has been known as Iowa State University of Science and Technology.

ACCREDITATION, SESSIONS AND ENROLLMENT

The University is fully accredited by the North Central Association of Colleges and Secondary Schools, and is a member of the Association of American Universities.

Instruction is offered throughout the year, divided into 4 quarters of approximately 11 weeks each. Most undergraduates attend 3 quarters, September to June, but an increasing number are taking advantage of the summer program.

In 1970 Iowa State had an enrollment of 19,620 and a faculty which numbered approximately 1,900.
CURRICULA AND PROGRAMS

The University is organized into seven colleges. The main academic programs of each are listed below, together with the degrees or certificates awarded upon completion. In many cases, certain majors, options, or electives allow for increased specialization within the programs. Programs which are administered jointly by two colleges are listed within each college. The technical institute programs are administered by the appropriate colleges.

COLLEGE OF AGRICULTURE

Leading to the degree Bachelor of Science:

Agricultural Business
Agricultural Communication
Agricultural Education
Agricultural Engineering
Agronomy
Animal Science
Biometry
Dairy Science
Entomology
Farm Operation
Fisheries and Wildlife Biology
Food Technology
Forestry
Horticulture
Landscape Architecture
Outdoor Resource Development
Plant Pathology
Poultry Science
Public Service and Administration in Agriculture
Urban Planning

Leading to a certificate in technical agriculture:

Agricultural Business
Agronomy
Animal Science
Dairy Science
Farm Operation
Horticulture

Leading to a certificate of completion:

Winter Quarter Program in Farm Operation

COLLEGE OF EDUCATION

Leading to the degree Bachelor of Science:

Elementary Education
Industrial Education

Leading to the Iowa professional teaching certificate:

Agricultural Education
Art
Biology
Chemistry
Earth Science
Elementary Education
English
Foreign Languages
General Science
Home Economics Education
Industrial Education
Journalism
Mathematics
Music
Nursery School—Kindergarten
Physical Education for Men
Physical Education for Women
Physics
Safety Education
Social Studies
Speech

COLLEGE OF ENGINEERING

Leading to the degree Bachelor of Science:

Aerospace Engineering
Agricultural Engineering
Construction Engineering
Ceramic Engineering
Chemical Engineering
Civil Engineering
Electrical Engineering
Engineering Operations
Engineering Science
Industrial Engineering
Mechanical Engineering
Metallurgy
Leading to the degree Bachelor of Arts:

Architecture

COLLEGE OF HOME ECONOMICS

Leading to the degree Bachelor of Science:

Applied Art
Child Development
Family Environment
Food and Nutrition
Home Economics Education
Home Economics
Home Economics Journalism
Institution Management
Physical Education for Women
Textiles and Clothing

COLLEGE OF SCIENCES AND HUMANITIES

Leading to the degree Bachelor of Science:

Anthropology
Bacteriology
Biochemistry
Biology
Biophysics
Botany
Chemistry
Computer Science
Distributed Studies
Earth Science
Economics
English
French
Geology
German
History
Industrial Administration
Mathematics
Metallurgy
Meteorology
Music
Naval Science
Philosophy
Physical Education for Men
Physical Education for Women
Physics
Political Science
Psychology
Russian
Sociology
Spanish
Speech
Statistics
Science Journalism
Zoology

COLLEGE OF VETERINARY MEDICINE

Leading to the degree Doctor of Veterinary Medicine:

Veterinary Medicine

TECHNICAL INSTITUTES

Leading to the associate diploma:

Food Service Management
Engineering Technologies (Chemical Industries, Construction, Electronics, Mechanical)

GRADUATE COLLEGE

The Graduate College confers the degrees master of architecture, master of arts, master of education, master of engineering, master of forestry, master of landscape architecture, master of science, and doctor of philosophy.

SPECIAL PROGRAMS

—Military training is offered through three separate ROTC programs—the Army, Navy and Air Force. Training is on an elective basis. A student who completes a program of four years may be commissioned as a military officer.

—Inter-institutional programs offer students the opportunity of completing two years of study in another institution, then completing the last two years at Iowa State without the formality of transferring. Several such programs are offered by the College of Home Economics.

—Dual degree programs allow students who complete the first three years in certain curricula at Iowa State and who satisfactorily complete the first year in a recognized medical, dental, veterinary medical, or law curriculum to be awarded the degree bachelor of science from Iowa State.

—The Iowa Lakeside Laboratory at Lake Okoboji offers two terms of five weeks each in June, July, and August. A cooperative program in teaching and research, this summer laboratory for the biological sciences is sponsored by Iowa State University, the University of Northern Iowa, and the University of Iowa.
RESEARCH AND SERVICE AGENCIES

Research plays a large role at Iowa State. Most faculty members engage in research pursuits as well as teaching. Graduate students, and in some cases undergraduates, receive the stimulation which comes from being a part of the never-ending search for new knowledge. The awareness of new developments and new ideas pervades the campus.

A year's operating budget for all research at the University is approximately $30 million, much of it from contracts or grants involving the federal government and industry.

As part of its total program the University also operates extension services, special laboratories, and institutes.

AGRICULTURE AND HOME ECONOMICS EXPERIMENT STATION

Floyd Andre, Ph.D., Director
John P. Mahlstede, Ph.D., Associate Director
Solon A. Ewing, Ph.D., Assistant Director
Helen LeB. Hilton, Ph.D., Assistant Director

Agricultural research at Iowa State traces its history to the beginning of the University, when the original farm provided an opportunity for research with livestock, crops, and horticultural material. The Hatch Act, passed by Congress in 1887, gave federal support to agricultural investigations; the formal beginning of the Agriculture and Home Economics Experiment Station dates from that time. Additional federal, state, and private support enabled the Station to reach its present program in both basic and applied research.

In addition to the main station at Ames, experimental work is conducted at a number of outlying farms and in the fields of many farmer cooperators throughout the state. These experimental areas have been selected to represent specific soil types of the state where special problems can be studied on a local basis.

Part of the unusual efficiency of Iowa farmers can be credited to research findings from the Agriculture and Home Economics Experiment Station.

Currently research is being conducted in:

agricultural bacteriology  animal science  forestry
agricultural education  biochemistry  genetics
agricultural engineering  economics  home economics
agricultural journalism  entomology  horticulture
agricultural statistics  fisheries and wildlife biology  plant pathology
agronomy  food technology  poultry science

ENGINEERING RESEARCH INSTITUTE

David R. Boylan, Ph.D., Director

Organized in 1904 to conduct investigations on engineering problems and to promote industrial development of the state, the Engineering Research Institute is the research arm of the College of Engineering and undertakes research in fields involving all of its academic departments.

Major research personnel of the Institute are also active in teaching, and a large portion of the research activity is related directly to graduate instruction and training. Research projects are generally initiated and supervised by the staff.
Research is funded by state appropriations and by industrial and governmental grants and contracts.

Major research programs include:

- agricultural product utilization
- process chemistry
- ceramic materials
- power systems analysis
- automatic navigation and control
- computers
- solid-state devices
- gas dynamics
- fluid mechanics
- highway materials
- turbomachinery
- sanitary engineering
- soils and structures
- biomedical engineering
- microwave propagation
- water resources

Major laboratories are maintained for electron microscopy, low-turbulence aerodynamics and heat transfer, bituminous materials, sanitary engineering, soils, structures, turbomachinery research, computers, radio astronomy, and high-voltage photoelasticity.

Facilities include aerodynamic shock tubes, low and high-speed wind tunnels, chemical process pilot plants, x-ray and infrared spectrometers, and analog and digital computers.

Technical service groups include machine shops, an electronics shop, an analytical laboratory, equipment inventory, and an editorial service.

A brochure describing current research programs is published annually. A copy may be obtained by writing to the Engineering Research Institute, 104 Marston Hall.

**HOME ECONOMICS RESEARCH INSTITUTE**

Helen LeB. Hilton, Ph.D., Director

The Home Economics Research Institute, established in 1966, operates as a part of the College of Home Economics. Objectives of the research are coordinated with those of the resident instruction and extension programs in home economics with emphasis on the family, education for effective family living, and provision of goods and services needed by individuals and families.

Research in home economics is administered by the Institute or the Agriculture and Home Economics Experiment Station.

Research is conducted in the fields of applied art, child development, family environment, food science, home economics education, institution management, nutrition, textiles and clothing, and physical education for women.

**SCIENCES AND HUMANITIES RESEARCH INSTITUTE**

Chalmer J. Roy, Ph.D., Director

The College of Sciences and Humanities sponsors and administers research programs through the Sciences and Humanities Research Institute. The primary objective is to encourage basic research which can provide knowledge to aid in the solution of industrial, social, and agricultural problems in Iowa. The Institute works closely with other campus research agencies.

Research is conducted in the fields of:

- anthropology
- bacteriology
- biochemistry
- biology
- biophysics
- botany
- cell biology
- chemistry
- computer science
- earth science
- economics
- English
- foreign languages
- geology
- history
- industrial administration
- mathematics
- metallurgy
- meteorology
- music
- philosophy
- physics
- political science
- psychology
- sociology
- speech
- statistics
- zoology
During World War II, a small group of scientists and coworkers at Iowa State played a very important role in the atomic energy program. Through their efforts, a process was developed and demonstrated for making high purity uranium metal. Before the process was turned over to industry, over 2,000,000 pounds of uranium metal were produced on campus in a temporary building. Shortly after World War II, Major General Leslie R. Groves presented the Ames project employees with the Army-Navy "E" award for excellence in industrial production of a vital war material.

In order that the program of the University in this field might be carried forward in peacetime, the Iowa State University Institute for Atomic Research was authorized by the Iowa State Board of Regents on Nov. 1, 1945.

The objective of the Institute is to develop the peacetime uses of atomic energy and the by-products from it. Specifically, its purposes are:

- To build and maintain a strong group of scientists working in the fundamental phases of physics and chemistry as they apply to nuclear processes and to develop the aspects of physics, chemistry, metallurgy, and engineering which are naturally associated with these fields.

- To have available on the campus a group of experts in these newer developments so other members of the faculty can consult them concerning the application of these new tools to their own problems.

- To encourage cooperation and coordination in this type of research work on the campus on a voluntary basis. Particular emphasis is placed on borderline fields between the several sciences where expert advice is needed from several different fields.

- To carry out research whereby graduate students may obtain the specialized knowledge and skills which they will need in order to do independent research in these fields. The formal course work is given and degrees awarded through the several departments and colleges.
Due to the outstanding record of achievement made by the Iowa State project during the war years, the Atomic Energy Commission decided to continue this program of research in the nuclear and associated fields at Iowa State University in the postwar period. Accordingly, it established on the campus one of its major research centers known as the Ames Laboratory of the Atomic Energy Commission. This Laboratory specializes in the basic and pioneering types of research necessary to the development of the fields associated with atomic energy.

The University has leased to the Atomic Energy Commission areas on campus for the Metallurgy, Research, and Metals Development Buildings and the Ames Laboratory Research Reactor. Because virtually all of the work done is of a fundamental and basic nature, which is not classified, results of the research normally are published in the scientific journals. The Laboratory also provides research opportunities for several hundred graduate students and part-time work for a number of advanced undergraduate students.

**VETERINARY MEDICAL RESEARCH INSTITUTE**

Ralph L. Kitchell, D.V.M., Ph.D., Director
E. Edward Wedman, D.V.M., Ph.D., Associate Director

The Veterinary Medical Research Institute is a multi-discipline institute with a responsibility to conduct research and offer research training in comparative medicine. Research and research training are conducted in the areas of infectious diseases of animal and man as well as in basic biology.

The Veterinary Medical Research Institute occupies land adjacent to the campus proper. It has a complement of research laboratories and large and small animal isolation units. Experimental animals of a specialized nature are produced at the Institute for research and research training purposes.

The Institute includes 12 professional faculty members with specialized training in the fields of parasitology, epidemiology, microbiology, pathology, physiology, and biochemistry and their supporting staff.

No graduate courses are offered by the Institute; however, faculty members hold academic appointments in the departments of the University and memberships in the Graduate College. This arrangement allows the faculty to advise graduate students and to offer research training opportunities through predoctoral, postdoctoral, and visiting scientist training programs.

The faculty of the Institute also participates in the instructional programs of the University by assisting the academic departments in their course offerings.

**WATER RESOURCES RESEARCH INSTITUTE**

Don Kirkham, Ph.D., Director
Kenneth J. Frey, Ph.D., Administrative Adviser

This institute receives money and recommends its allocation for research in all aspects of water resources. The institute has been designated by the United States Department of the Interior to receive funds for the State of Iowa under Public Law 88-379, the Water Resources Research Act of 1964.
COMPUTATION CENTER

Clair G. Maple, D.Sc., Director
Robert M. Stewart, Ph.D., Associate Director
Dale Grosvenor, Ph.D., Assistant Director
C.C. Mosier, B.S., Assistant Director

The Computation Center was organized in 1962 to provide an all-University computing service and a centralized facility for research and education in the computer sciences. University staff members and students having problems suited for digital computation can use the computing service as well as a consulting service. The Center maintains a variety of computing facilities ranging from punch card equipment through large scale analog and digital computers. Peripheral equipment includes an analogue-to-digital conversion system, and a digital plotter and several types of remote terminal devices.

The Center offers short, noncredit courses in computer programming and provides liaison for academic departments offering formal courses using the computer. Research encompasses numerical mathematics, programming research, digital computer systems, and computer-assisted instruction. Standardized programs and systems have been developed to support a wide range of applied research areas including common statistical packages, linear programming, and selective dissemination of information.

STATISTICAL LABORATORY

T.A. Bancroft, Ph.D., Director

The Statistical Laboratory is a research and service institute which conducts research in statistical theory and methodology and promotes and fosters the use of sound statistical methods in University research. Established in 1933, it was the first statistical center of its kind in the United States.

The Laboratory cooperates closely with research workers in all colleges of the University. Staff and facilities are maintained for statistical consulting aid, statistical numerical analysis and data processing, sample survey operations, and statistical design and analysis of surveys and experiments. Similar consulting aid, research cooperation, and services are extended to off-campus groups, other colleges and universities, and civic groups when such activities are of mutual benefit or otherwise in the public interest.
CENTER FOR AGRICULTURAL AND ECONOMIC DEVELOPMENT
Earl O. Heady, Ph.D., Executive Director

The Center is concerned with the economic, social, and political changes resulting from national economic growth and a technological revolution. The transformation of agriculture affects not only farm people and rural communities, but people and institutions throughout society.

The Center assists research and educational institutions to understand—and shape—necessary social and economic adjustments. It also concerns itself with the role of U.S. agriculture in aiding underdeveloped nations in economic growth and political maturity.

The following are major lines of Center endeavor:

- Original research as well as the synthesis and interpretation of existing knowledge to explain adjustment and development problems facing agriculture and the community—and also the alternative policies that can be applied to solve these problems.
- Cooperative seminars, conferences, and educational programs with other research and educational institutions.
- Special programs for major public audiences concerned with an understanding of changes implied for agriculture and rural communities.
- Help to the land-grant universities to modify their organization and programs in order to assist people in coping with the rapidly changing needs of the times.
- Direct educational work with audiences especially selected because of their sensitivity to public decision making. The goal here is to give people an understanding so they can make intelligent, informed decisions on the problems and public policy alternatives for adapting the institutional systems to the changing societal structure.

The Center holds fact-finding seminars, organizes conferences and workshops, publishes reports, and pursues other lines of activity to achieve its objectives. It is supported in part by a grant from the W.K. Kellogg Foundation.

INDUSTRIAL RELATIONS CENTER
Edward B. Jakubauskas, Ph.D., Director

A growing concern about the social results of an increasing technology led to the establishment of an Industrial Relations Center at Iowa State by the Board of Regents in June 1966.

The central focus of research is upon the behavior of individuals and organizations in an employment and labor force relationship.

The Center provides an interdisciplinary approach to the study of labor market processes, utilizing faculty and research assistants from the disciplines of economics, sociology, psychology, industrial engineering, and political science.

Present research activities are concentrated in six major areas: health manpower, occupational employment forecasting, managerial and leadership studies, manpower program evaluation, collective bargaining and arbitration, and labor force behavioral studies.

The Industrial Relations Center is funded through grants and contracts from the U.S. Department of Labor, the U.S. Office of Education, and a private foundation. The University also provides financial support.

VETERINARY MEDICAL DIAGNOSTIC LABORATORY
Vaughn A. Seaton, D.V.M., M.S., Head

The Veterinary Medical Diagnostic Laboratory was established in 1947 to provide a facility to which the Iowa animal industry and veterinary medical profession can bring their problems for counsel and assistance. Through the Laboratory, the technical and professional assistance of the College of Veterinary Medicine can be made available. The Laboratory functions in all
discipline areas of veterinary medicine necessary to provide diagnostic assistance. It is organized into functioning units of pathology, microbiology, and chemistry-toxicology with all their pertinent sub-disciplines.

The Laboratory is an integral part of the College of Veterinary Medicine and serves as a department whose primary function is service. It is a valuable link between the practicing veterinarian and the teaching and research staff of the College of Veterinary Medicine and through this link many areas of research have been expanded. The Laboratory annually receives thousands of specimens from all parts of Iowa for examination. It cooperates closely with the state and federal disease control and public health agencies on the local, state and national levels.

The Diagnostic Laboratory serves as a teaching laboratory for both undergraduate and graduate students in the College of Veterinary Medicine. In this laboratory the students assist with field disease problems and receive firsthand information regarding the total disease picture, including history, symptoms, treatments, postmortem examination, gross and microscopic examinations, and a host of diagnostic procedures and techniques in all veterinary medical disciplines in the characterization and identification of etiological agents. In addition, the laboratory is engaged in applied research projects concerned with animal disease problems as well as new techniques of diagnosis of animal diseases.

The modern physical plant of the laboratory is equipped with diagnostic and analytical facilities and instrumentation used in microbiological, chemical, toxicological, and pathological examination.
University Extension was established March 1, 1966, by the inclusion in a single administrative unit of four service groups which had previously operated separately.

Through the combined University Extension program the total resources of Iowa State can be brought to bear on urban and rural problems which result from rapid social and economic changes now developing throughout Iowa.

Iowa State has a long and distinguished history of being of service to the people where they work and live. It has pioneered many areas of extension operations. The unified program is designed to extend this tradition, and to contribute broadly to the well-being of the citizens of the state.

Included in University Extension are the Cooperative Extension Service in Agriculture and Home Economics, Engineering Extension, the Center for Industrial Research and Service, and Extension Courses and Conferences.

Cooperative Extension Service in Agriculture and Home Economics

Marvin A. Anderson, Ph.D., Director

Among the programs offered by Cooperative Extension are agricultural production, conservation of national resources, efficient marketing and distribution of farm-raised products, family living, 4-H club work, youth development, community improvement and resource development.

A central staff, headquartered on the campus, and a field staff with headquarters in every county in the state, work with nearly 50,000 local volunteer leaders in carrying out various Extension activities.

The University was charged with its present responsibilities in Cooperative Extension by action of the state legislature in 1906. In 1914 Congress passed the Smith-Lever Act which provided for Cooperative Extension work in the land-grant college system. The United States Department of Agriculture, the University, county governments and local organized groups are cooperators in this enterprise. Financial support comes from state, federal, and county appropriations.

Engineering Extension

R.E. Patterson, Jr., B.S., Director

Established at Iowa State in 1913 by the Iowa General Assembly, Engineering Extension is supported by fees from participants, by state appropriations, and by certain federal funds. Engineering Extension conducts noncredit courses throughout the state and offers videotaped graduate-credit courses taught by faculty members from the College of Engineering.

Specific programs include:

- An Engineering Management Institute to assist industry in developing engineering and management personnel.
- Fire extension training for volunteer and paid departments, industrial brigades, and fire department officers, instructors, and inspectors.
- Junior Engineering Technical Societies, which provide insight into engineering and applied science for students in high schools.
- Industrial electronics education for industry and others involved in electronic controls or appliances.
- Custodial education to provide assistance to those involved in building maintenance.
- Civil defense education for elected and appointed city officials and others interested or involved with civil defense problems.
- Engineering courses for all branches of engineering.
Center for Industrial Research and Service (CIRAS)

Waldo W. Wegner, B.S., Director

CIRAS was established in 1963 to provide a facility on campus to which Iowa industry can bring its problems for counsel and assistance. Through the Center, technical and engineering assistance of Iowa State University and other talents of a wide variety in the state are made available to Iowa industry in these ways:

- Coordination of industrial needs with technical capabilities and the broad range of specialized industrial talents throughout Iowa.
- Assistance with special problems facing industry in Iowa by full-time staff employed by CIRAS.
- Publication of information from research and field contacts by CIRAS relating to industrial climate and growth in Iowa.

Counseling and information can be provided directly to industry by CIRAS staff, or through assistance of other University staff members. Referrals are made to other state agencies, private professional organizations, or other colleges in Iowa.

CIRAS does not duplicate or overlap activities now undertaken by established groups in the state. It coordinates and supplements activities of other organizations and performs functions which cannot easily be undertaken by academically oriented university departments. The Center works to provide an integrated research and service function oriented toward industrial needs. It provides a coordinated approach to the usual industrial problems which contain implications reaching from basic research to the organization, management, and implementation of the results of technical and theoretical discoveries.

Extension Courses and Conferences

George H. Ebert, M.S., Leader

Extension courses, university credit courses, and informal continuing education programs are offered as part of the broad educational and service base of the University.

Economic, technological, and social modifications and changes taking place within our society provide the rationale for such programs. The University provides the means whereby adult groups can meet to share information and gain knowledge pertaining to problems, systems, techniques, and research in areas of common interest and concern.

During the academic year off-campus credit courses are offered at locations throughout the state. Academic departments provide University faculty members to teach the credit courses offered through University Extension.

Short courses, conferences, institutes, and workshops comprise a rapidly growing informal continuing education phase of Extension Courses and Conferences. More than 30,000 persons attend the 180 programs each year devoted to a wide range of subjects.

The Office of Extension Courses and Conferences provides assistance in the initiation, planning, operation, and administration of off-campus credit courses and other continuing education programs. In addition, bulletins and schedules of events are published quarterly. Copies may be obtained by writing the Office of Extension Courses and Conferences, Curtiss Hall, Iowa State University, Ames, Iowa, 50010.

An individual, organization, group, or agency interested in participating in such educational programs may contact the Office of Extension Courses and Conferences.
**Admission and Registration**

Arthur M. Gowan, Ph.D., Dean of Admissions and Records  
Fred C. Schluenz, M.S., Associate Dean and Registrar  
Wayne A. DeVaul, B.S., Director of Admissions  
Karsten Smedal, B.S., Associate Director of Admissions  
Maurice Geist, M.A., Associate Director of Admissions  
William Yungclas, B.S., Assistant Director of Admissions  
John V. Sjoblom, M.A., Associate Registrar  
Dean Nelson, M.A., Assistant Registrar  
Herman Richtsmeier, M.S., Assistant to the Registrar

Iowa State University continues its long established policy of admission without regard to race, color, creed or national origin.

Application for admission to Iowa State University may be made by writing to the Director of Admissions, Beardshear Hall, Iowa State University, Ames, Iowa 50010. The applicant should state his educational background and indicate the area in which he plans to study. The Director of Admissions will then forward application blanks and detailed information concerning the admissions process.

The Admissions Office, Beardshear Hall, is open Monday through Friday from 8 a.m. to 11:50 a.m. and from 1 p.m. to 5 p.m. and on Saturdays from 8 a.m. to 11:50 a.m. Prospective students are encouraged to visit the Admissions Office in person to discuss with counselors any problems or questions that may arise in connection with admissions. Personal visits are not required, however, and in most cases admission can be completed by mail.

Students planning to enter as freshmen should make application early in their senior year of high school. Inquiries about admission are welcomed at any time.

Candidates for admission generally are informed of the action taken on their applications within a few days after all necessary forms are in the hands of the Director of Admissions.

**ADMISSION REQUIREMENTS**

In general, requirements for admission as a freshman to Iowa State are that the student be in the upper half of his secondary school graduating class, that he take the American College Testing Program (ACT) tests or the College Boards (SAT), and that he present the necessary credits to meet the requirements of the curriculum he has selected.

Since there are many variations in the admissions process for freshman and transfer students, a detailed set of regulations has been drawn up by the State Board of Regents as follows:

**General Requirements**

**A. ADMISSION OF FRESHMAN STUDENTS**

A student desiring admission must meet the requirements in this section and also any special requirements for the college or curriculum of his choice. See also Specific Requirements.

He must submit a formal application for admission and must have the secondary school provide a certificate of high school credits, including a complete statement of the applicant's high school record, rank in class, scores on standardized tests, and certification of high school graduation. The applicant must also submit any other evidence, such as a certificate of health, that may be required.

1. A graduate of an approved Iowa high school who has the proper subject-matter background, who is in the upper one-half of his graduating class, and who meets specific curricular requirements will generally be admitted upon certification of graduation, if he applies for admission. A candidate who is not in the upper one-half of his graduating class may be required to take special examinations and may, after
a review of his entire record and at the discretion of the Admissions Officers: (1) be admitted unconditionally, (2) be admitted on probation, (3) be required to enroll for a tryout period during a preceding summer session, or (4) be denied admission.

2. A graduate of an accredited high school in another state must meet at least the same standards as a graduate of an Iowa high school. The options for admission by probation or tryout enrollment may not be open to these students. Each college reserves the right to demand higher standards from graduates of out-of-state high schools.

3. A graduate of an approved high school must submit all data as required above and in addition must take examinations which will demonstrate his general competence to do college work. Evidence of specific competence for admission to a given curriculum will also be required.

4. An applicant who is not a high school graduate must submit all data required above insofar as it exists and must take examinations to demonstrate general competence to do college work. Evidence of specific competence for admission to a given curriculum will also be required.

B. ADMISSION OF UNDERGRADUATE STUDENTS BY TRANSFER FROM OTHER COLLEGES

1. Students from accredited colleges and universities. Transcripts of record are given full value if coming from colleges or universities accredited by the North Central Association of Colleges and Secondary Schools or similar regional associations. For schools not regionally accredited, the recommendations contained in the current issue of the Report of Credit Given by Educational Institutions published by the American Association of Collegiate Registrars and Admissions Officers will be followed.
   a. Each applicant shall submit an official transcript bearing the official seal and signature of the official in charge of records from each college or university which the student has attended previously. The student will also submit any other records or letters which the University may require to support his application for admission.
   b. A transfer applicant shall be expected to have maintained a "C" average (2.00 based on an "A" grade being 4 points) for all college work previously attempted and not be under suspension from the last college attended. Students who are not residents of Iowa may be expected to have maintained a 2.25 grade index.
   c. A student who is below the above standard may be permitted to take entrance examinations. If the applicant successfully completes the examinations, he may be admitted on probation.
   d. In general, transfer applicants under academic suspension from the last college attended will not be considered for admission during the period of suspension or, if for an indefinite period, until six months have passed since the last date of attendance. When eligible for consideration, the applicant will be considered as in "C" above.
   e. A transfer applicant under disciplinary suspension will not be considered for admission until a clearance and a statement of the reason for suspension is filed from the previous college. When it becomes proper to consider an application from a student under suspension, Iowa State University must take into account the fact of the previous suspension in consideration of the application. An applicant granted admission under these circumstances will always be on probation and his admission subject to cancellation.
   f. Applicants for admission by transfer who do not meet the standards may be denied.
   g. Transfer credit from a junior college will not be accepted if that credit is earned after the total number of hours of credit accumulated by this student at all institutions attended exceeds one-half of the number of hours needed to earn the baccalaureate degree.

2. Students from nonaccredited colleges. The University may refuse to recognize credit from a nonaccredited college or may admit the applicant on a provisional basis and provide a means for the validation of some or all of the credit. The validation period shall not be less than one quarter and will ordinarily be a full academic year. The University will specify to the student the terms of the validation process at the time of provisional admission. Each student from a nonaccredited college will be considered on his merits and his admission or rejection is at the discretion of the admissions officer.

C. APPLICATION DEADLINES

Applicants for admission must submit the required applications for admission and the necessary official transcripts and other required documents to the admissions officer of the appropriate college at least 10 days prior to the beginning of orientation for the session for which the student is applying. Applications for admission from students who are required to take entrance examinations will not be considered unless the examinations can be completed at least five days before the beginning of orientation. This regulation may be waived by the admissions officer only for adequate reasons.

This regulation does not apply to the College of Veterinary Medicine. See Veterinary Medicine, Admission Requirements.

All new undergraduate students, except foreign students, are required to take the American College Tests (ACT's) or the College Boards (SAT's) and to arrange to have the results sent to this office. The tests should be taken at the earliest available date.

D. CLASSIFICATION OF RESIDENT AND NONRESIDENT STUDENTS FOR ADMISSION AND FEE PURPOSES.

1. General. Students enrolling at one of the three state institutions shall be classified as Resident or Nonresident for admission, fee, and tuition purposes by the Registrar. The decision shall be based upon information furnished by the student and all other relevant information. The Registrar is authorized to require such written documents, affidavits, verifications, or other evidence as are deemed necessary to establish the domicile of a student, including proof of emancipation or adoption, or appointment of a guardian. The burden of establishing that a student is exempt from paying the nonresident fee is upon the student.

*Examinations for the determination of general competence to do college work are determined by the Regents Committee on Educational Relations and are comparable for all three state institutions. Competence established at one is acceptable at all three, but due to different specific curricular requirements, does not guarantee admission to either of the other two.

*Application deadline for fall quarter is August 1.

Admission and Registration 105
For purposes of resident and nonresident classifications, the word "parents" as used herein shall include legal guardians or others standing in loco parentis in all cases where lawful custody of any applicant for admission has been awarded to persons other than actual parents.

2. Residence for Tuition Purposes. Regulations regarding residence for admission, fee, and tuition purposes are generally divided into two categories—those that apply to students who are minors and those that apply to students who are over 21 years of age. The requirements in these categories are different.

3. Students Who Are Minors. The residence of a minor shall follow that of the parents at all times, except in extremely rare cases where emancipation can be proved beyond question. The residence of the father during his life, and after his death, the residence of the mother, is the residence of the unemancipated minor; but if the father and the mother have separate places of residence, the minor takes the residence of the parent with whom he lives or to whom he has been assigned by court order. The parents of a minor applying for admission will be considered residents of Iowa only if they have a domicile within the state at the time of the beginning of the semester or quarter in which the minor is first enrolled at Iowa State University or the State University of Iowa, or University of Northern Iowa, and if the parents establish such domicile for purposes other than to qualify their child for resident tuition. A minor admitted before his parents have moved to Iowa may be reclassified as a resident at the beginning of the next semester or quarter in which the student is enrolled after his parents have a domicile in Iowa. A minor student whose parents move their residence from Iowa to a location outside of Iowa shall be considered to be a nonresident at the beginning of the next semester or quarter in which the student is enrolled after the date of the parent's removal from the state.

4. Students Over 21 Years of Age and Married Students Under 21 Years of Age. A resident student 21 years of age or over or a married student under 21 years of age is (1) one whose parents were residents of the state at the time he reached his majority or was married if under 21 years of age, and who has not acquired a domicile in another state, or (2) who, while an adult, has established a bona fide residence in the state of Iowa by residing in the state for at least 12 consecutive months immediately preceding registration. Bona fide residence in Iowa may be proved beyond question. The residence of the father and the mother is subsequent to the time of the beginning of the semester or quarter in which the minor is first enrolled. Nonresident tuition will be charged in all cases under the beginning of the next semester or quarter in which the student is enrolled.

Dependents of persons whose legal residence is permanently established in Iowa, who have been classified as residents for tuition purposes may continue to be classified as residents so long as such residence is maintained, even though circumstances may require extended absence of said persons from the state. It is required that persons who claim an Iowa residence while living in another state or country will provide proof of the continual Iowa domicile such as (1) evidence that they have not acquired a domicile in another state, (2) they have maintained a continuous voting record in Iowa, and (3) they have filed regular Iowa income tax returns during their absence from the state.

Ownership of property in Iowa, or the payment of Iowa taxes, does not in itself establish residence. A student from another state who has enrolled for a full program or substantially a full program in any type of educational institution will be presumed to be in Iowa primarily for educational purposes, and will be considered not to have established residence in Iowa. Continued residence in Iowa during vacation periods or occasional periods of interruption to the course of study does not of itself overcome the presumption.

All students not classified as resident students shall be classified as nonresidents for admission, fee, and tuition purposes.

A student who willfully gives incorrect or misleading information to evade payment of the nonresident fees and tuition shall be subject to serious disciplinary action and must also pay the nonresident fee for each session attended.

An alien who has entered the United States on an immigration visa and who has established a bona fide residence in Iowa by living in the state for at least 12 consecutive months immediately preceding registration may be eligible for resident classification providing he is in the state for purposes other than to attempt to qualify for resident status as a student.

Men in military service (except career service men) who listed Iowa as their residence prior to entering service and who, immediately upon release, return to Iowa to establish their residence or enter college, will be classified as residents unless their parents moved from the state while the individual was still a minor.

Change of classification from nonresident to resident will not be made retroactive beyond the semester or session in which application for resident classification is made.

5. General Facts. The resident status for admission, fee, and tuition purposes of a married student shall usually be determined under these rules irrespective of the classification of the spouse. Married students under 21 years of age shall be considered to have attained legal age as of the date of their marriage.

Persons who are moved into the state as the result of military or civil orders from the government, or the minor children of such persons, are entitled to resident status. However, if the arrival of the parents is subsequent to the time of the beginning of the semester or quarter in which the minor child is first enrolled, nonresident tuition will be charged in all cases under the beginning of the next semester or quarter in which the student is enrolled.

6. Review Committee. The decision of the Registrar on the residence of a student for admission, fee, and tuition purposes may be appealed to a Review Committee. The finding of the Review Committee may be appealed to the Board of Regents.
Specific Requirements

The following requirements are in addition to those given in Section A.

1. Undergraduate Students
   A minimum of one unit of algebra is required for admission to all curricula.
   A non-high school graduate, in addition to meeting standards in Section A, must be at least 17 years of age and have an unqualified recommendation from his high school principal. Requirements for admission to the several colleges are given below.

   College of Agriculture—A minimum of one and one-half units of algebra is required of students entering any four-year curriculum. In addition, the curricula in Agricultural Journalism, Forestry, Industrial Education, and Landscape Architecture require one unit of geometry. Students who have not completed all of the required mathematics courses may take geometry or third-semester algebra at Iowa State University. The requirements for admission to Agricultural Engineering are the same as for the College of Engineering.

   College of Education—Two units of mathematics are required. One of the units must be algebra. The other unit may be algebra, geometry, and/or trigonometry in any combination. Students who have not completed all of the required mathematics may take geometry or third-semester algebra at Iowa State University.

   College of Engineering—One unit of geometry and one and one-half units of algebra are required. Students who have not completed all of these courses may take geometry or third-semester algebra at Iowa State University.

2. Graduate Students
   See Graduate College, Admission Requirements.

3. Technical Institute Students
   One unit of geometry and one and one-half units of algebra are required. Students who have not completed all of these courses may take geometry or third-semester algebra at Iowa State University during the summer preceding their admission into the program. Unconditional admission to the Technical Institute may be granted to students who are not in the upper one-half of their graduating class.

HEALTH EXAMINATION

A health examination is part of the admission process for all students. Each new student is sent a form to be filled out by his physician and returned to the Student Health Service. The examination is to be completed and the form returned before registration.

University physicians study reports of the physical examinations in placing students in proper physical education classes and in qualifying them for military training when necessary.

New students are requested to furnish the results of a tuberculin test and/or chest x-ray made within the preceding year. If none is available, these may be obtained at the University Health Service.

It is advisable to have remediable defects in vision corrected and to have necessary dental work accomplished before entering the University. Vaccinations for smallpox and poliomyelitis, as well as tetanus toxiod inoculations, are also advised.

ORIENTATION

Orientation is the individual experience of a student becoming acquainted with the various resources and opportunities that are available within the University. The primary opportunities are provided in the summer and fall orientation programs with some continued involvement in the fall quarter.

Some colleges, however, hold special orientation sessions for transfer students during spring quarter. These sessions are very similar to the two-day summer orientation sessions described below, except that they are held on a weekend. The transfer student may choose to come on any one of several weekends.

One-day orientation sessions are also held at the beginning of winter quarter, spring quarter, and both summer sessions for all new students entering at any of these times.

Cyclone Aides, upperclass Iowa State students, are available at all orientation programs to answer questions about student life at Iowa State. The Aides are a diverse group of men and women representing all colleges and all residence units, and are from both in-state and out-of-state. They have been selected and trained with one purpose in mind—to help acquaint new students and their parents with Iowa State.
Summer Orientation

To welcome students and parents to Iowa State, and to accomplish more thoroughly some of the orientation activities which ordinarily mark the beginning of the fall quarter for new students, the University holds a summer orientation program.

The specific procedures vary somewhat according to the college the student is entering. In general, students are asked to select a convenient time from among a number of two-day periods which are scheduled between the beginning of June and the middle of July. They are requested to come to the campus during the period which they select for the orientation program. Parents are urged to accompany students whenever possible.

Students and parents are housed in campus residence halls for nominal fees, or may choose to stay at hotels and motels in Ames. Meals may be purchased at University facilities or in Ames restaurants. Cyclone Aides live in the residence halls with the new students and are available at all times for informal interaction with new students and parents.

Included in the orientation session is a testing program for students so they may be placed in class sections according to their abilities and aptitudes. Both students and parents are briefed by faculty members on matters of curriculum, study, and university life in general. Considerable time is spent answering individual questions with the Cyclone Aides. Special sessions are available on college costs, current concerns of the University community, and student life. Campus bus tours and entertainment are also included in the program. Each student has a personal conference with an academic adviser to outline his program of study.

Fall Orientation (New Student Week)

All new students, including transfer students, are required to attend New Student Week, which precedes the opening of fall quarter.

The fall orientation is designed to assist a student in making a personal adjustment to the University and to enable him to become acquainted with the resources for intellectual and personal development.

New Student Week is developed by upperclass students at Iowa State and includes a closer look at a new student’s college and department, a look at activities at Iowa State, an interaction series with faculty, residence orientation, entertainment, and many other activities. Cyclone Aides are again available to help new students with any questions that they might have.

The underlying philosophy of the fall orientation program is to offer many activities, so that new students may attend those that will be most beneficial to them as they begin their life at Iowa State.

REGISTRATION

Registration and the payment of assessed fees are required of all who attend classes. Registration is not complete until fees are paid, including board and room fees for those living in residence halls. The fee payment period for a quarter extends through the second day of classes, and a late fee is attached for payments made after that date.

The instructor in each class receives from the Office of Student Records a class list showing all students properly registered for his class. This list serves as his authority to admit the students to class. Additional students should be admitted only upon presentation of an official add slip. Students are permitted to audit nonlaboratory classes. This means they may attend the class as visitors but may not participate in discussions or make claims upon the time of the instructor. Approval to audit must be obtained from the dean, and the payment of regular fees is required.

CLASSIFICATION

Students are not admitted to any class nor are they dropped from any class except by permission of their dean. Students may not classify at conflicting hours without the approval of the departments concerned. Any student may be required to drop work which is not being accomplished in a satisfactory manner.

A change from one college to another within the University requires the permission of
the dean of the college to which the student wishes to transfer. A change from one curriculum to another in the same college requires the approval of the dean of the college as well as the head of the curriculum to which the student wishes to transfer.

TRANSCRIPT OF RECORD

One transcript of a student's academic record is provided without charge, upon request, to each student. Each additional single copy beyond the first is $1. In multiple orders, following the first copy for which no charge is made, the first additional copy charge is $1, and additional copies are 25 cents each.

WITHDRAWAL

A student who withdraws from the University during any quarter for which he is enrolled should report to his dean. Those who withdraw receive refunds according to University policy outlined under Fees and Expenses.

ADVANCED PLACEMENT

Iowa State is not at present a part of Advanced Placement Program sponsored by the Educational Testing Service. However, it is possible for a student to advance as far as his background will permit. A student may take an examination for credit in any course taught in the University, provided he can show to the satisfaction of the department head concerned and his dean that he has made the necessary preparation. This may have been through high school courses or independent study. If the student meets the standard of the department in the course in which he is being examined, the credit will become a part of his University record. A grade of T is recorded and does not become a part of the student's cumulative average.
All fees and expenses listed in this catalog were effective as of September 1, 1970. They are subject to change at any time thereafter without notice.

A registration fee is charged all students of the University. A full undergraduate registration fee covers laboratory fees, hospital service, use of the Library, membership in the Memorial Union, and a number of student activities. For graduate students and students on light classification, the activity fee is optional. Students who are not residents of Iowa pay an additional tuition fee each quarter. This is assessed in accordance with regulations of the State Board of Regents, found in this catalog under Admissions.

**ESTIMATE OF EXPENSES**

An undergraduate enrolling at Iowa State and living in a residence hall will find the following basic expenses will cover one academic year (three academic quarters):

<table>
<thead>
<tr>
<th></th>
<th>Iowa Resident</th>
<th>Nonresident</th>
</tr>
</thead>
<tbody>
<tr>
<td>Registration fee</td>
<td>$600</td>
<td>$600</td>
</tr>
<tr>
<td>Tuition</td>
<td>$200</td>
<td>$235</td>
</tr>
<tr>
<td>Board and room</td>
<td>$630</td>
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<tr>
<td>Books, supplies and equipment (estimated)</td>
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<td>$150</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>$1620</td>
<td>$2250</td>
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</table>

The above figures make no allowance for clothing, transportation, social and recreational expenses, laundry, or a variety of incidental expenses. These vary widely with the individual student, but should be considered carefully as part of the total cost of attending the University.

Further information regarding board and room expenses is found in this catalog under Student Housing.

**FEE SCHEDULE**

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<thead>
<tr>
<th></th>
<th>Iowa Resident</th>
<th>Nonresident</th>
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</thead>
<tbody>
<tr>
<td>Per quarter</td>
<td>$200</td>
<td>$235</td>
</tr>
<tr>
<td>Per summer session</td>
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<tr>
<td>Light classification, fee per hour</td>
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<td>29</td>
</tr>
<tr>
<td>Fee reduction</td>
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<td>120</td>
</tr>
<tr>
<td>0 or no credit course, fee per course</td>
<td>75</td>
<td>75</td>
</tr>
<tr>
<td>R credit course, fee per course</td>
<td>25</td>
<td>29</td>
</tr>
<tr>
<td>Reinstatement after registration cancellation</td>
<td>10</td>
<td>10</td>
</tr>
</tbody>
</table>

Audit—Same as light classification
Off-campus—Same as light classification
In absentia—Same as light classification
Interim Fee—Same as light classification
### Fees and Expenses

<table>
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<tr>
<th>Service</th>
<th>Iowa Resident</th>
<th>Nonresident</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Undergraduate</td>
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<tr>
<td>Lakeside Laboratory</td>
<td>$100</td>
<td>$100</td>
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<td>Driver education</td>
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<td>25</td>
</tr>
<tr>
<td>Special women's education</td>
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<td>20</td>
</tr>
<tr>
<td>Change of classification</td>
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<td>1</td>
</tr>
</tbody>
</table>

### Private Music Instruction

- **University students, per quarter**
  - 10 lessons per quarter, 1 credit: $30
  - 20 lessons per quarter, 2 credits: $50
- **Non-university students, per quarter**
  - 10 lessons per quarter, 1 credit: $33
  - 20 lessons per quarter, 2 credits: $55

- Electric organ practice: $10
- Pipe organ practice: $15
SPECIAL STUDENTS AND NONCOLLEGIATE STUDENTS

Special students and noncollegiate students pay the same fees as undergraduates.

REGISTRATION FEE FOR STUDENTS WITH FEE REDUCTIONS

For students with fee reductions, the registration fee for each of the fall, winter, and spring quarters is $120. For either term of the summer quarter, the fee is $60.

This fee covers laboratory fees, hospital service, use of the Library, and membership in the Memorial Union. An activity fee is optional.

APPLICATION FEE

A fee of $10 must accompany the application for admission and is nonrefundable except in the case of residents of Iowa who are denied admission. This fee will not apply to special students or workshop applicants.

ADVANCE FEE PAYMENT

Nonresident undergraduates and special students are required to make an advance partial fee payment of $50 before final admission is made.

This $50 payment is applied at registration time toward the fees for the first quarter. The payment is not refunded if the student does not register.

LATE REGISTRATION

A fee of $5 for the first day and $1 per day thereafter is charged to those who do not complete registration during the regular registration period. Maximum charge for late registration is $10.

ACTIVITY FEE

Students whose payments do not include the activity fee may pay $9 per quarter and receive admission to concerts, lectures, and debates and subscriptions to several student publications. An additional charge is made for admission to football and basketball games.

SENIOR FEE

A $2 fee covers the cost of special senior activities.

REFUNDS

Refunds are made on the unused portions of fees for registration, room, and board under the following policy:

Registration fee and room rental—Ten percent is deducted for each week or part of a week that the student is enrolled, but no refund is granted if the student is in the University beyond the fifth week of the quarter. In each summer session, 20 percent is deducted for each week or part of a week, with no refund after the third week.

Board charges—Ten percent is deducted for each week or portion of a week that the student is enrolled in the University.

Each quarter begins on the registration day immediately preceding the opening of classes and continues through the day previous to graduation day.
Student Housing

Charles F. Frederiksen, M.S., Director of Residence
Richard S. Holtz, M.S., Assistant Director of Residence
Larry H. Ebbers, M.S., Assistant Director of Residence
Daniel A. Hallenbeck, M.A., Assistant Director of Residence
Robert J. Benson, M.S., Assistant to the Director of Residence
Doris J. Hittle, M.S., Administrative Dietitian
George F. Patten, Manager of Married Housing
Roy C. Owings, Jr., Residence Hall Accountant
Jay R. Miller, Manager of Food Stores
William H. Willroth, Supervisor of Maintenance
Ruth A. Stoner, M.S., Administrative Assistant
Margaret E. Naylor, M.S., Program Adviser
Jean E. Worthan, B.S., Program Adviser
Kenneth L. Stoner, B.S., Program Adviser
Robert E. Fulwider, B.S., Program Adviser
Carlton E. Moen, M.S., Program Adviser

The University provides housing facilities for approximately 3,000 single undergraduate women, 5,300 single undergraduate men, 1,350 married students, 272 single graduate men, and 118 single graduate women. Chapter houses are maintained near the campus by 36 fraternities and 14 sororities. They house approximately 2,500 students. Other students live in private rooms and apartments in Ames or nearby communities.

Students admitted to the University will receive from the University Admissions Office a form to be used to request a housing application. The student's name will be placed on the waiting list for assignment according to the date that the completed application and the housing deposit is received in the Office of the Director of Residence. Admission to the University is necessary before obtaining a housing application.

A $25 deposit is required at the time a room and board contract is completed for accommodations in the residence halls, when an application card is completed for a married student apartment operated by the University, or when a lease is signed with an owner for private off-campus housing.

Address correspondence concerning housing to the Director of Residence, Friley Hall, Iowa State University, Ames, Iowa 50010.

UNDERGRADUATE RESIDENCE HALLS

Residence halls at Iowa State have complete facilities for comfortable living. All halls have attractive lounges. Recreation rooms and club facilities are available for residents. Each hall has a woman resident adviser, and a student head resident resides within each house in the hall.

Most rooms in residence halls are planned for double occupancy. They are furnished with single beds, innerspring mattresses, chest of drawers, individual study desks, chairs and telephone. Students provide their own bed linens, mattress pads, throw rugs, blankets, pillows, towels, and study lamps. They maintain the cleanliness and order of their own rooms. A linen rental service is available.

All undergraduate women, except those 21 years of age or over and those who have made special arrangements with the Director of Residence, are required to live in residence halls or sororities.

Cafeteria-style food service is provided for all residents in the halls.
A single student who resides in an undergraduate residence hall signs a contract for room and board for the academic year. All charges are subject to change without notice, but the rate for the academic year starting September, 1970, was $870.

Students should not request rooms in the residence halls if they do not plan to occupy them for the academic year. Most fraternities ask pledges to live in the chapter house part of the year. Therefore, students who plan to pledge and live in a fraternity should not seek a room in a residence hall.

GRADUATE RESIDENCE HALL

Buchanan Hall provides housing in 174 single rooms and 108 double rooms for unmarried graduate students. A suite-type room plan provides a semi-private bath shared by the occupants of two single rooms or two double rooms. There is a public area joining the eight story men's wing with the four story women's wing. It includes a lounge, television room, recreation area, vending room, laundry rooms, and administration office. There is a small lounge on each floor of each wing.

Rooms are furnished with single beds, innerspring mattresses, chest of drawers, individual study desks, chairs, and room telephone. Students provide towels and study lamps. Bed linens are furnished, and maid service is provided weekly.

The room rate as of September 1970 was $130 per quarter in a double room or $170 per quarter in a single room. A meal ticket may be purchased for $178 per quarter (as of September 1970) to eat in Linden Hall.
MARRIED STUDENT HOUSING

The University provides 668 World War II barrack-type apartments in Pammel Court, 196 permanent apartments in Hawthorn Court, and 550 permanent apartments in University Village for student families. Rates for these married student apartments as of September 1970 were $40 per month in Pammel Court, $85 per month in Hawthorn Court, and $100 per month in University Village. Apartments are unfurnished except for stoves and refrigerators in Hawthorn Court and University Village. Water service and garbage removal are included in the rental. The tenant pays for his own gas, electricity, and telephone.

Approximately half of Iowa State married students live in University apartments. The remainder find accommodations in private houses, apartments, or trailer courts in and near Ames.

A list of off-campus apartments for married students may be seen at the University Married Housing Office.

Applications for University-owned apartments will be accepted after admission to the University but not more than one year in advance of attending the University.

Address correspondence concerning married housing to the Director of Residence, University Married Housing Office, 100 University Village, Iowa State University, Ames, Iowa 50010.

OFF-CAMPUS HOUSING FOR SINGLE STUDENTS

A list of off-campus rooms and apartments may be seen at the Single Off-Campus Housing Office, 1209 Friley Hall.

The single room rental rates average $10 per week; the double room rental rates average $8 per person per week. The student usually furnishes his own bed linens, towels, and study lamp. Board for students living in off-campus rooms may be obtained in private restaurants or the Memorial Union.

It is best that the student come to Ames well in advance of the time he plans to begin academic work, so that he may select off-campus quarters which best fit his requirements and make arrangements directly with the owner.
THE UNIVERSITY LIBRARY

Warren B. Kuhn, M.S., Director

The University Library collection affords open-shelf access to more than 800,000 volumes. Additional holdings of 275,000 microfilms and other microtext materials are available in a wide range of subject areas. The Library is particularly strong in the basic and applied fields of the biological and physical sciences and has embarked on a rapid program of extensive growth in the humanities and social sciences. Very complete holdings of periodicals are maintained in botany, chemistry, entomology, mathematics, physiology, and veterinary medicine. The Library receives approximately 13,000 journals and other serial publications, amounting to world coverage in many scientific fields in major and minor languages.

The Library encourages use of its collections, services, and study facilities. The entire ground floor of the Library's newest addition is devoted to undergraduate services, including reserves, periodicals, and books selected primarily for the undergraduate. Instruction in the use of books and libraries is offered to graduate and undergraduate students.

Exhibits of new books in all subjects are maintained on open-shelf display on the main floor. Current numbers of selected periodicals are displayed in alcove browsing areas throughout the building. Special exhibits of books, posters, photographs, art work, and other materials are scheduled for display during the academic year.

STUDENT COUNSELING SERVICE

Roy E. Warman, Ph.D., Director

Ronald D. Baker, Ph.D. Charles W. Jones, M.S.
Ellen L. Betz, Ph.D. Marianne L. McManus, Ph.D.
Martin O. Bielefeld, Ph.D. Daniel M. McMillen, Ph.D.
Willis K. Bright, Jr., M.A. John W. Menne, Ph.D.
Russell J. Canute, Ed.D. Phyllis G. Miller, Ph.D.
Eugene S. Cherry, Ph.D. Charles A. Poe, Ph.D.
Martin F. Fritz, Ph.D. Paul Tempel, M.D.
Donald G. Zytowski, Ed.D.

The central activity of the Student Counseling Service is counseling with students on a broad range of their problems. The focus may be on educational, vocational, or personal adjustment matters. Testing is provided when appropriate, and there is no charge for regularly enrolled students. Discussions between student and counselor are confidential. Occasionally the student may want information sent to his academic adviser or some other official; this is something which is decided in consultation with the counselor and done with the written permission of the student.

The staff of the Student Counseling Service also provides services to others in the University, such as assistance in research projects concerned with student characteristics, scoring and analysis of objective classroom examination, advice on development of questionnaires, or administration of orientation testing.

STUDENT HEALTH SERVICE

Gail McClure Proffitt, M.D., Director

C.V. Hamilton, M.D. V.T. Ryding, M.D.
J.H. Gardner, M.D. George J. Uhl, M.D.
Kenneth C. Piercy, M.D. Ludomira Furman, M.D.

The University maintains a well-equipped hospital and dispensary for the care of students. Routine medical advice and treatment are given through the dispensary without charge.
Medicines and services such as X-ray are provided at cost. Hospital service is at a nominal rate, but full fees for special nurses or consulting physicians are paid by the student. Special diets for such conditions as diabetes and ulcers are served at a diet table at the hospital. The University physicians are authorized to exclude from the residence halls and classrooms any persons afflicted with a contagious disease and, if necessary, those coming in contact with such disease.

**STUDENT HOSPITALIZATION INSURANCE**

Student hospitalization, accident, and sickness insurance at a favorable rate is available on a voluntary basis to all students who are enrolled at the University.

**PLACEMENT OFFICES**

The University maintains offices in the areas of agriculture, engineering and sciences, home economics, teaching, and veterinary medicine where employers and prospective employees are brought together. Each of these offices assists students about to graduate, and alumni who are changing positions, who seek information on career openings in their fields. Sometimes undergraduates can be helped to find summer employment.

**OFFICE OF THE DEAN OF STUDENTS**

Arthur Sandeen, Ph.D., Dean of Students

Thomas Goodale, M.A., Associate Dean of Students  
Marita Jones, M.A., Assistant Dean of Students  
Lynn M. Jenison, M.S., Assistant Dean of Students  
Willis K. Bright, Jr., M.A., Program Adviser  
Jean Palmer, M.S., Sorority Adviser  
Ronald Hill, B.A., Fraternity Adviser  
William Bogue, B.S., Orientation Coordinator  
Dennis Kelso, B.S., Program Adviser  
Mary Anne Gibson, B.S., Program Adviser

Functioning in the broad area of student life, the Office of the Dean of Students concerns itself with the self-development and individual welfare of each Iowa State student. It serves as a general counseling agency and clearing house of information for all students and student groups. Working with individuals and with groups, it is concerned with the individual's growth and the educational environment that assists student development. Specifically, staff members in this office work with student leaders, fraternities, sororities, and members of the Independent Student Association; counsel foreign students; supervise social and activity programs; provide financial counsel and assistance; handle disciplinary matters; and coordinate the religious activities of campus groups and the various churches in Ames.

The Office of the Dean of Students also interprets to the faculty and administration factors which may contribute to a student's learning (needs, values, mores, social, emotional and cultural development); communicates student views to the administration and, when necessary, attempts to modify any practices which interfere with the student's growth and welfare.
The Office of Foreign Student and Visitor Services assists foreign students with problems arising from legal, immigration, or personal matters; assists American students in applying for Fulbright, East-West Center, and other educational grants; provides information for studying, teaching, and working opportunities abroad for both teachers and students; involves itself in the coordination of activities between the community, U.S. students and foreign students; and coordinates the itineraries of foreign visitors and staff members whose professional interests coincide with teaching and research programs at Iowa State University.
Financial Aid

Edgar Swanson, M.S., Supervisor of Financial Aids
Michael White, B.A., Assistant Supervisor
Thomas Budnik, M.S., Assistant Supervisor
Eva Fields, M.S., Assistant Supervisor
John Thompson, M.S., Assistant Supervisor

A large number of Iowa State University students depend in part upon their own savings, employment, scholarships, grants, or loans for financing their university educational program. In most cases, a combination of resources is used to meet financial needs which cannot be met by families of the students.

The award of a scholarship, grant, or loan is based upon a systematic review of the financial and academic background of each applicant. Iowa State University uses the services of two independent needs-analysis systems to aid in making these awards. Both the Parents' Confidential Statement (PCS) of the College Scholarship Service and the Family Financial Statement (FFS) of the American College Testing Service are accepted as applications for financial assistance. Upperclassmen should check concerning application deadlines for renewal awards.

Detailed information pertaining to all facets of the financial aids program at Iowa State University may be obtained from the Student Financial Aids Office, Room 12, Beardshear Hall.

HIGH SCHOLARSHIP RECOGNITION AWARDS

High school graduates in the upper one or two percent of their high school graduating classes are recognized for their high scholarship by a cash award and a certificate of merit. These awards are made at the time of admission to the University, and no application is necessary.

SCHOLARSHIPS

To be considered for a scholarship or grant, a new student (freshman or transfer student) must file a Parents' Confidential Statement and be admitted to the University by March 1. No other formal application blank is necessary.

Most scholarships and grants are issued on the basis of need and academic achievement, not academic achievement alone. Parents' Confidential Statements will be accepted until March 1 for scholarships and grants effective in the fall quarter.

High school students should contact their principals or counselors for information about the National Merit Scholarship, National Science Talent Search Scholarship, and possible local scholarships. A new student may also contact the dean of his college at the University for further information about scholarships. High school officials can also provide information about Social Security benefits, aid to war orphans, and aid to physically handicapped students.

Unless otherwise stated, inquiries should be directed to the Office of Student Financial Aids, Room 12, Beardshear Hall.

EDUCATIONAL OPPORTUNITY GRANTS

The Higher Education Act of 1965 affirms the policy of the United States to strengthen the educational resources of our colleges and universities and to provide financial assistance for students in post-secondary and higher education. Title IV of the Act initiates a program of Educational Opportunity Grants, through institutions of higher education, to assist in making available the benefits of higher education to qualified high school graduates of exceptional financial need who for lack of means of their own or their families would be unable to obtain these benefits without such aid. Students who feel they may qualify for such a grant should have their parents file a Parents' Confidential Statement and be admitted to the University by
March 1. Further information on these grants may be obtained from the high school counselor or by writing the Office of Student Financial Aids, Room 12, Beardshear Hall. Parents’ Confidential Statements are available at the high schools.

**STUDENT EMPLOYMENT SERVICE**

To assist students in securing part-time employment, the University maintains a student employment service as part of the Office of Student Financial Aids, Room 12, Beardshear Hall. Most part-time employment of students on campus is found in the residence halls dining service, University Library, Memorial Union, offices, and laboratories. Inquiries concerning employment in the residence halls dining service should be directed to 1212 Friley Hall. Students interested in employment with the Memorial Union should contact the Union directly. Odd jobs such as yard work and housework may be found, as well as jobs with businesses in Campus Town and downtown Ames.

The University cannot guarantee employment, but many students each year find jobs through the Employment Service.

Those students who plan to earn a large portion of their expenses are advised to carry a reduced schedule of academic work.

**COLLEGE WORK-STUDY PROGRAM**

Students, particularly those from low-income families, who need a job to help pay for college expenses may be eligible for employment under the federally supported Work-Study Program. Under this program, students may work up to 15 hours per week while attending classes. During certain vacation periods students may work up to 40 hours per week.

To work under this program, a student must be enrolled and in good standing, or have been accepted for enrollment as a full-time student. The student’s eligibility depends upon his documented financial need for employment to help defray college expenses, with preference given to applicants from low-income families. Students may apply for the Work-Study Program in the Office of Student Financial Aids, Room 12, Beardshear Hall.

**STUDENT LOAN FUNDS**

Long-term loans, to be paid after graduation or withdrawal from the University, are available through the University Loan Program, the Federally Insured Loan Program, or the National Defense Student Loan Program.

The amount loaned from both the University and the National Defense Student Loan Programs is determined by need, availability of funds, and an evaluation of scholastic achievement. As such, it is necessary that a student interested in these types of loans file a Parents’ Confidential Statement.

Emergency loans are available during registration periods at a modest charge. No advance application for these emergency loans is necessary. An individual must state the purpose of his loan and be in good standing academically in order to qualify.

All loans must be used for educational purposes, which basically are room, board, tuition, and books.

**STUDENT AID FUNDS**

Student aid funds, which are limited in size and number, require no interest from the borrower. These funds include the Electrical Engineering and Equipment Fund, Frances Coover Aid Fund, Mary Huncke Student Loan Fund, John Baylor Loan Fund, and Ralph W. Atkinson Aid Fund.

The following is a list of active loan funds available to Iowa State students. New loan funds are started frequently. Applications are made at the Office of Student Financial Aids, Room 12, Beardshear Hall.
FEDERALLY INSURED LOAN PROGRAM (GUARANTEED LOAN)

The Federally Insured Loan Program is a program of borrowing primarily for students from middle- or upper-income families. Half- or full-time students who are in good academic standing may be eligible to borrow up to $1,500 per academic year through their local lending institution. Upon graduation or withdrawal, the student has an obligation to repay his loan at an interest rate of seven percent.

If the student qualifies for federal interest subsidy, the Federal Government pays all the interest, to a maximum of ten percent per year, while the student remains in school if his adjusted family income is less than $15,000 per year.

HEALTH PROFESSIONS STUDENT LOAN AND SCHOLARSHIP PROGRAMS

The Health Professions Student Loan Program was authorized by the Health Professions Education Assistance Act of 1963. The purpose of this program is to increase the opportunities for the training of physicians, dentists, and veterinarians by offering low-interest loans to students who demonstrate financial need.

The Health Professions Scholarship Program is a program to assist talented youth having exceptional need for financial assistance to undertake the course of study required to become a physician, dentist, or veterinarian.

A student interested in either of these programs must submit a Parents' Confidential Statement.
All-University Scholarships

A Parents' Confidential Statement will give a student consideration for the following freshman scholarships: General, Alumni Achievement, Class, Freshman Lane Wells, General Motors, and any new scholarships that might not be listed.

C.G. Adams Scholarship for a member of Delta Upsilon social fraternity. No application necessary.

Alumni Achievement Fund Scholarships for freshmen and undergraduates. See headnote.

Athletic Grants-in-aid for graduating high school seniors. Established by the Big Eight Conference Universities. Apply to Department of Athletics.

George Washington Carver Scholarship for students enrolled in the Department of Technical Journalism.

Lowell L. Carver Industrial Education Scholarship for undergraduates majoring in Industrial Education with a 2.00 grade point average.

George W. Catt Memorial Scholarships for seniors. No application necessary.

Class Scholarships for freshmen and undergraduates. Established by the classes of 1906, 1907, 1908, 1911, and 1915. See headnote.

Delta Delta Delta Scholarship for an undergraduate woman. Apply to Delta Delta Delta Sorority, 302 Ash Avenue, after arrival at Iowa State University.

Epsilon Chapter of Tau Kappa Epsilon Fraternity Scholarship for a member of that fraternity. No application necessary.

General Motors (College Plan) Scholarship for freshmen. See headnote.

General University Scholarships for freshmen and undergraduates. See headnote.

Dean Helser Class of 1955 Scholarship for sophomores and juniors selected by the Scholarship and Awards Committee.

Independent Student Association Scholarships for ISA freshmen and sophomores. Apply to Independent Student Association, Memorial Union.

Interfraternity Council Scholarship for a freshman. Apply to Interfraternity Council after arrival at Iowa State University.

Iowa State Club of Chicago Scholarship for a student who will graduate from a high school in the West Suburban and Suburban League of Chicago. Apply to high school principals of respective schools.

Lane-Wells Scholarships for freshmen. See headnote.

Lane-Wells Scholarships for seniors. No application necessary.

LaVerne Noyes Scholarships for freshmen and undergraduates who are blood descendants of men who served in World War I. Apply first quarter in the University, 12 Beardshear Hall.

G.W. Morrison Scholarship for students with a financial need who have shown qualities of leadership, ability, and future credit to ISU.

1915 Scholarship for undergraduates in any of the colleges.

Postmasters of Iowa Scholarship for sophomore and junior students who are children or grandchildren of an Iowa postmaster or a deceased Iowa postmaster. Provided by the Postmasters' Training School. Apply to the Financial Aids Office, 12 Beardshear Hall.

Slilk and Fair Award Scholarship for all students not classified as freshmen or graduates.

Veishea Scholarships for Iowa freshmen. Application blanks are sent to high schools. Applications may be made after student completes seventh semester of high school. Applications are due by March 31. Questions should be directed to: Career Day Director, Veishea Central Committee, Memorial Union.

Walnut Grove Products Company Scholarship for a junior, based on an essay on a chosen subject. No application necessary.
Alden Wilson Scholarship for seniors. Must earn major part of expenses and have high scholastic standing.

Madge Young Memorial Scholarship for a Men's Residence Association junior or senior with a 2.25 grade point or above. Apply to MRA president.

Scholarships Listed Under Two or More Colleges

These scholarships are available to students of more than one college.

Hazel Beck Andre Journalism Scholarship for a junior in journalism in the College of Agriculture or Home Economics. Apply to Department of Journalism and Mass Communication.

James W. Bell "Christmas" Scholarship for a science or engineering freshman. No application necessary. Selected once every four years.

Farm Journal, Inc. Scholarships for freshmen in agricultural journalism and home economics journalism.

W.E. Holmes Scholarship for a journalism major. Apply to Department of Journalism and Mass Communication.

Journalism Tuition Scholarships for students majoring in journalism. Apply to Department of Journalism and Mass Communication.

William Kershner Scholarship for a student majoring in journalism. Apply to Department of Journalism and Mass Communication.

Minneapolis Tribune Scholarship for a senior in journalism.

Ruth Watkins Newton Scholarship for a journalism major. Apply to Department of Journalism and Mass Communication.

R.C.A. Scholarship for a senior in electrical engineering or physics. No application necessary.

Agricultural Scholarships

Applications for freshman scholarships must be submitted by March 1. Application dates for the sophomore, junior, and senior scholarships are publicized by the College of Agriculture. Students should contact their adviser or the Awards and Scholarship Committee, 121 Curtiss Hall, for further information about these scholarships.

Agrico Scholarship for a junior in agronomy, horticulture, or plant pathology. Sponsored by Continental Oil Company.

Agricultural Marketing Management Scholarship for agricultural business undergraduates in the marketing management option. Sponsored by the Iowa Grain and Feed Association.

Alcoa Foundation Agricultural Scholarships for residents of Iowa in their freshman year.

Allied Mills 4-H Scholarship for juniors majoring in animal science. 4-H background necessary. Apply to State 4-H office by Sept. 1.

William C. Bryant Scholarship for animal and dairy science seniors. No application necessary.

Burpee Award in Horticulture for a junior or senior in horticulture. No application necessary.

C.H. Chase Honorary Scholarship for a sophomore in agricultural business with an interest in the retailing of farm equipment. Sponsored by the Iowa Retail Farm Equipment Association.

Chevron Chemical Co. 4-H Scholarships for freshmen majoring in agronomy, entomology, horticulture, or plant pathology. 4-H background required. Apply to State 4-H Office by Sept. 1.
Chicago Mercantile Exchange Scholarship for an Iowa freshman.

Chicago and North Western Railway 4-H Scholarship for male agricultural business or forestry juniors, seniors, or graduate students. 4-H background and essay necessary. Apply to State 4-H Office by Sept. 1.

Chicago Farmers' Club Scholarship for a senior.

J. Milton Cone Scholarship for a sophomore, junior or senior in forestry. No application necessary.

Cooperative Education Scholarships for freshmen interested in cooperative management who are residents of Cedar, Clinton, Henry, Jackson, Johnson, Jones, Keokuk, Linn, Louisa, Muscatine, Scott, or Washington counties. During summers the students must work at one of the sponsoring cooperatives in the 12-county area.

Danforth Summer Leadership Training Scholarship for a freshman. Sponsored by the American Youth Foundation.

J.N. "Ding" Darling Foundation Scholarships for fisheries and wildlife biology students who have an interest in the promotion and communication field.

Davenport Wheel and Canvas Club, Inc. Conservation Scholarship for an undergraduate student with an interest in conservation.

Delicious Apple Tree Scholarship for a freshman in horticulture. Sponsored by the Iowa Horticulture Society. No application necessary.

Donelson Scholarship for students enrolled in agriculture or home economics.

Henry R. Duncan Scholarship for an undergraduate in animal or dairy science.

Electric Cooperative Pioneer Scholarship for a freshman in agricultural journalism.

E.S. Estel Scholarship for a junior or senior in food technology or dairy science. Sponsored by the National Dairy Congress in Waterloo.

Farm Journal Scholarship for a freshman in agricultural journalism.

Farmland Industries, Inc. Scholarships for juniors and seniors who are male residents of Iowa and whose parents belong to an agricultural cooperative.

Farmers National Farm Management Scholarship for a junior in agricultural business, agricultural education, agronomy, animal science, dairy science, or farm operation who has an interest in professional farm management.

Federal Land Bank of Omaha and Federal Land Bank Association in Iowa Scholarships for male freshmen from Iowa farms.

Federated Garden Clubs of Iowa, Inc. Scholarships for undergraduates in horticulture and landscape architecture. No application necessary.

FS Services, Inc. Scholarships for junior and senior students having an interest in a career in business.

B.J. Firkins Memorial Scholarship for a sophomore in agronomy. Sponsored by the friends of the late Prof. B.J. Firkins. No application necessary.

Goke Scholarships for agriculture undergraduates. In honor of Alvin Goke.

Golf Course Superintendents Association of America Scholarships for juniors and seniors enrolled in turf management program.

Wayne W. Gross Memorial Scholarship for a freshman from Carroll County.

George Gund Animal Science Awards for seniors in animal science. No application necessary.

E.S. Haber Award for a freshman in horticulture. Sponsored by the Horticulture Club. No application necessary.

E.S. Haber Scholarship for a horticulture or landscape architecture undergraduate majoring in nursery management or planning a career in the landscape nursery business. Sponsored by the Iowa Nurserymen's Association. No application necessary.
Heaberlin Agronomy Award Scholarship for seniors who have attended an Iowa high school and are majoring in agronomy.

Homelite 4-H Scholarships for freshmen in forestry. 4-H background required. Apply to State 4-H Office by Sept. 15.

W.J. Hughes Award for a senior in horticulture. No application necessary.

International Milling Company Scholarship for a senior in animal, dairy and poultry science or agricultural business.

Iowa Crop Improvement Association Scholarship for a junior or senior in agronomy. No application necessary.

Iowa Limestone Scholarship for a junior or senior in agronomy. Sponsored by the Iowa Limestone Producers Association. No application necessary.

Iowa Master Farmer's Club Scholarships for agricultural journalism undergraduates.

Iowa Pest Control Operators Association Scholarship for an entomology undergraduate. No application necessary.

Iverson Honorary Dairy Industry Scholarships for food technology undergraduates. Sponsored by alumni and friends in honor of Prof. C.A. Iverson. No application necessary.

Izaak Walton League of America and Auxiliary Scholarships for students in fisheries and wildlife biology. Sponsored by several Izaak Walton League chapters in Iowa. No application necessary.

Izaak Walton League Ottumwa Chapter Scholarship for a junior or senior from southeastern Iowa counties who is majoring in agricultural engineering, fisheries and wildlife biology, forestry, or outdoor recreation.

Russell I. Klopp Award for a senior in horticulture. No application necessary.

Knights of Ak-Sar-Ben Scholarships for freshmen from Iowa counties which had exhibitors at the Ak-Sar-Ben livestock show the previous year.

Moorman Manufacturing Company Scholarships for freshmen and sophomores.

Poultry Industry Scholarships for students in poultry science. Sponsored by the members of the poultry industry of Iowa.

Production Credit Associations in Iowa Scholarships for male freshmen from Iowa farms.

Ralston Purina Company Scholarship for a junior or senior in agricultural business, agricultural education, agricultural engineering, agricultural journalism, agronomy, animal science, dairy science, farm operations, food technology, or poultry science.

Rice Estate Advanced Curriculum Scholarships for juniors and seniors.

Rice Estate International Service Scholarships for juniors or seniors taking the Preparation for International Service in Agriculture program.

Paul P. Stewart Memorial Scholarship for a sophomore, junior, or senior student in dairy science, sponsored by dairymen and friends of the late Paul P. Stewart.

H.K. Wilson Advanced Curriculum Scholarship for a sophomore who has earned a 3.0 cumulative average.

Chuck Worcester Intern Scholarship for a junior to work one summer as a farm editor and one school year as a campus correspondent.

Zimmerman Memorial Prize for a junior in horticulture. No application necessary.

**Engineering Scholarships**

Applications for all College of Engineering scholarships, awards, and aid funds must be made in triplicate by Jan. 30. All scholarship applications should be addressed to the Scholarships and Awards Committee, College of Engineering, 104 Marston Hall. Application blanks are available in the various departmental offices. In this section only, a reference to an undergraduate refers to a sophomore, junior, or senior.
Alcoa Engineering Achievement Scholarship for an engineering senior.

Alcoa Engineering Scholarships for undergraduates in engineering.

American Institute of Industrial Engineers Scholarship for a senior in industrial engineering.

Associated General Contractors Scholarship for a junior or senior in civil engineering or a second-year student in construction technology.

Babcock and Wilcox Scholarships for undergraduates in engineering and engineering technology.

Black and Veatch Scholarships for freshmen in civil engineering.

Boeing Scholarships for juniors or seniors in electrical, mechanical, aerospace, and civil engineering, and industrial administration.

Bourns Inc. Scholarship for a junior or senior in electrical, mechanical, or industrial engineering.

Amos E. Buetell Memorial Award for a senior in mechanical or electrical engineering.

Continental Oil Company Scholarship for an undergraduate in chemical engineering.

Dr. J.B. Davidson Scholarship for an undergraduate student in agricultural engineering.

Durant, Delinger, Dommer, Kramer, and Gordon Scholarship for a senior in architecture.

Ferro Corporation Scholarship for a junior or senior in ceramic engineering.

Almon H. Fuller Scholarship for a senior in civil engineering.

Murray Gautsch Scholarship for a student in ceramic engineering.

Gibbs-Cook Scholarship for an engineering junior or senior with interest in the construction industry.

Goodyear Scholarship for a senior in chemical or mechanical engineering.

A.P. Green Refractories Scholarship for a student in ceramic engineering.

Frank W. Griffith Educational Award for a senior in architecture.

Walter Handy Memorial Scholarship for a junior in civil engineering.

Henning H. Henningson Memorial Scholarship for an electrical engineering freshman from a rural community.

Burdette Higgins Award Scholarship for a graduating senior in architecture.

Iowa Limestone Producers Association Award for a senior in civil engineering.

Frank Kerekes Memorial Scholarship for a junior or senior in civil engineering.

Peter Kiewit Sons' Co. Scholarship for a senior in civil engineering.

Kimball Scholarship for students enrolled in the College of Engineering.

Link-Belt Speeder Corporation Scholarship for a junior or senior in mechanical engineering or a second-year student in mechanical technology.

Fred F. Loy Memorial Award for a junior or senior in civil engineering.

Master Builders of Iowa Scholarship for a junior or senior in construction engineering or civil engineering.

The Maytag Scholarship in Engineering for a senior in mechanical or industrial engineering.

Keith B. Merrill "Christmas" Scholarship for a junior or senior in civil engineering.

Minnesota Mining and Manufacturing Company Scholarships for engineering undergraduates.

Missouri Valley Machinery Company Scholarships for engineering freshmen.

Guy W. Morrison Scholarship for a junior or senior in civil, electrical, industrial, or mechanical engineering, or technical journalism.

Carl E. Nelson Scholarship for a junior or senior in engineering.
Herman W. Nelson Memorial Scholarship for a senior in mechanical, electrical, or industrial engineering.

Pennsylvania Glass Sand Corporation Scholarship for a senior in ceramic engineering.

Pioneer Lumber Company Scholarship for a civil engineering junior or senior.

Sheffield Brick and Tile Company Scholarship for a ceramic engineering sophomore, junior or senior.

C.W. Shirey Prize Fund for undergraduates in civil engineering.

Standard Oil of California Scholarships for an undergraduate in chemical or mechanical engineering.

Russell Thompson Memorial Scholarship for an undergraduate sophomore.

Herbert O. Ustrud Memorial Scholarship for a senior in civil engineering.

Western Electric Fund Scholarship for an engineering undergraduate.

Leonard Wolf Memorial Scholarship for a junior or senior in architecture.

Home Economics Scholarships

Applications must be submitted by April 1 for freshman scholarships and by March 1 for upperclass scholarships. Unless otherwise stated below, send applications to the Home Economics Scholarship and Awards Committee, 122 MacKay Hall. For further information, inquire at the Office of the Dean of the College of Home Economics.

Home Economics Alumnae Scholarships from Alumni Achievement Funds for undergraduate students in home economics.

Janice Peterson Anderson Purchase Award. Recognition through purchase award of art work of distinguished quality by students of the Department of Applied Art. Annual purchases of fine examples of art for a permanent collection.

Marietta Bamble Anderson Award Fund for students in applied art and textiles and clothing. Inquire at Applied Art or Textiles and Clothing Department, MacKay Hall.

Grace M. Augustine Scholarship for a graduate student in institution management. Inquire at Institution Management Department, 11E MacKay Hall.

Bishop Buffeta, Inc. Scholarships for men in four-year institution management degree programs and in the two-year food service management technical institute. Inquire at Institution Management Department, 11E MacKay Hall.

Helen Alice Burling Scholarship for a sophomore, junior, or senior student in home economics.

Campbell Soup Home Economics Scholarships for 1970-1974 awarded to sophomore, junior, or senior students in food and nutrition with a major in food science.

Lillian Storms Coover Memorial Scholarship for a graduate student in nutrition or dietetics. Inquire at Food and Nutrition Department, 107 MacKay Hall.

Frances H. Crawford Scholarship for a person who intends to work in school food service or is now engaged in school food service work and wishes to prepare further for responsibilities of school food service administration. Inquire at Institution Management Department, 11E MacKay Hall.

Danforth Leadership Training Scholarship for a home economics freshman.

Delta Phi Delta Award for an upperclass student in applied art. Established by a bequest in the will of Joanne Hansen. Inquire at Applied Art Department, 215B MacKay Hall.

Julie Diekmann Memorial Award for a senior woman in applied art. No application necessary.

Donelson Scholarship for students enrolled in agriculture or home economics.

Farm Journal Scholarship for a high school student planning to major in home economics journalism. Inquire at Department of Journalism and Mass Communication.

Vera Foreman Friley Scholarship for a home economics senior.
Financial Aid

Anna Lee Garret Gautsch Scholarship for an undergraduate student in home economics who has demonstrated high scholarship and proficiency in the natural and physical sciences. No application.

Gerber Lillian Storms Coover Scholarship for a sophomore, junior or senior student in food and nutrition.

Lorraine Wells Hill Scholarship for sophomore, junior or senior student in home economics.

Home Economics Alumni Scholarships for sophomore, junior, or senior students in home economics. Established by the ISU Home Economics Alumni Association.

Iowa County Extension Home Economists Association Scholarship for a freshman student in home economics. Inquire at any County Extension Office.

Iowa Home Economics Association Scholarship for a freshman with 4-H or FHA record and a graduate of an accredited Iowa high school. Make inquiry to Scholarship Committee, Iowa Home Economics Association.

Howard Johnson's Scholarship for a student enrolled in the Department of Institution Management. Inquire at Institution Management Department, 11E MacKay Hall.

Millie Kalsem Award for a student in food and nutrition.

Catherine MacKay Scholarship for a home economics freshman.

Martha Moffit Scholarships for undergraduate students in food and nutrition majoring in dietetics. Inquire at Food and Nutrition Department, 107 MacKay Hall.

P. Mabel Nelson Scholarship for a sophomore, junior, or senior student in food and nutrition who is interested in pursuing graduate study in food science or nutrition.

Esther Compton Ogland Memorial Scholarship for an Iowa resident who is a senior in home economics education.

Florence Pen Scholarship for an undergraduate in food and nutrition. Inquire at Food and Nutrition Department, 107 MacKay Hall.

Sears Roebuck Foundation Scholarships for undergraduate students in home economics with preference for students entering teaching or planning careers as home economists in urban or rural poverty areas.

Julia McCollough Smith Award for a home economics senior with highest average grade point during at least seven consecutive quarters preceding the senior year. No application necessary.

Stouffer Restaurant Corporation Scholarship for a sophomore, junior, or senior student in institution management.

Tall Corn Chapter of Club Managers Association of America Scholarship for an Iowa resident who is a sophomore, junior, or senior in institution management. Inquire at Institution Management Department, 11E MacKay Hall.

John R. Thompson Company Scholarship for a student enrolled in the Department of Institution Management. Inquire at Institution Management Department, 11E MacKay Hall.

Veishea Cherry Pie Award for an undergraduate or graduate student in institution management. Established by Institution Management Club and Institution Management Department. Inquire at Institution Management Department, 11E MacKay Hall.

Florence Walls Scholarship for sophomores and juniors.

Sciences and Humanities Scholarships

Unless otherwise indicated, apply to the Scholarships Committee, 12 Beardshear Hall.

Gertrude Herr Adamson Scholarship in Mathematics for an undergraduate student who has displayed ingenuity in mathematics. No application necessary.

Archer-Daniels-Midland Company Scholarship for a senior in chemistry. Apply to Chemistry Department.
Chemistry Department Awards for freshmen, sophomores, juniors, and seniors in chemistry who display outstanding scholarship. No application necessary.

Collins Radio Company Award in Physics for the senior who demonstrates highest competence in physics. No application necessary.

Dow Chemical Company Scholarship for a freshman in chemistry. Apply to Chemistry Department at end of first semester of high school senior year.

Earl May Seed Company Scholarship for a junior in botany. No application necessary.

Ernst and Ernst Accountancy $250 Scholarship offered by the Department of Industrial Administration. No application necessary.

George Freeman Memorial Scholarship for a junior, senior, or graduate student in general or rural sociology.

Dio Lewis Holl Award to an outstanding senior who completes his work in the current academic year in the curriculum in mathematics. No application necessary.

Iowa Science Talent Search Scholarship for a high school senior who is a participant in the National Talent Search of Science Clubs of America.

Thomas H. McBride Scholarships in Natural Sciences to undergraduates for expenses at Iowa Lakeside Laboratory. Apply to Director, Iowa Lakeside Laboratory, Zoology Department, University of Iowa, Iowa City.

Minnesota Mining and Manufacturing Prize in Physics for a sophomore who shows outstanding promise for a career in physics. No application necessary.

Pi Mu Epsilon Award to a junior who has completed sophomore calculus and holds the highest scholastic average in freshman and sophomore mathematics and in general scholarship. No application necessary.

Purchasing Agents Scholarship for a junior or senior in the general area of purchasing. No application necessary.

Reader's Digest Scholarships to help cover the cost of projects undertaken by undergraduates or graduates in journalism. Apply to Department of Journalism and Mass Communication.

Veterinary Medicine Scholarships

Ak-Sar-Ben Awards to two students that have completed their third year of veterinary medicine curriculum. Apply to the chairman of the Equine Section, Veterinary Clinical Sciences.

American Veterinary Medical Association Women's Auxiliary Award for a senior veterinary student.

Borden Veterinary Medicine Scholarship for a senior with the highest grade-point average of veterinary students preceding the senior year.

G.G. Graham Scholarships for graduating seniors in clinical medicine.

Oris P. Idsvoog Memorial Award to a senior student interested in large animal medicine and surgery. Preference is given to seniors from the states of North Dakota and Wisconsin.

Iza Merchant Award for a College of Veterinary Medicine student's wife who has shown the greatest interest and has been active in the Auxiliary to the Iowa State Student Chapter of the American Veterinary Medical Association.

Merck Veterinary Manual Award given to a junior and a senior.

Charles Pfizer and Company Award for a junior in veterinary medicine. Applications are submitted to the Chairman of the Honors and Awards Committee.

Riser Small Animal Award for a senior in small animal medicine and surgery.

Paul F. Starch Phi Zeta Award for a freshman in veterinary medicine.

Charles Steele Memorial Award for a veterinary medicine sophomore.
Financial Aid

Upjohn Award for a senior who shows proficiency in large animal medicine.
Upjohn Award for a senior who shows proficiency in small animal medicine.
Walnut Grove Large Animal Nutrition Award for a fourth year veterinary student.

Iowa State University Veterinary Medical Alumni Association Scholarships

Henry Dale Bergman Award for a third year student in veterinary medicine.
George Judisch Scholarship Prize for the fourth year veterinary student with the highest scholastic average.
Ival Arthur Merchant Award for a second year student in veterinary medicine.
Burton C. Thompson Award for a first year veterinary student.
RELIGIOUS LIFE

Iowa State is a state-supported, nonsectarian institution, but it recognizes the importance of spiritual life and cooperates with the many off-campus groups which fulfill the religious needs of the community.

The Student Religious Council plans and coordinates programs designed to challenge students to a deeper exploration of their value commitments.

Most of the larger denominations have churches within easy walking distance of the campus. A number of these have built attractive student centers in connection with the churches and conduct extensive student programs under the direction of professionally trained persons.

The Young Men's Christian Association and the Young Women's Christian Association have active campus projects. The two Y's share Alumni Hall, a large building near the center of campus.

LECTURES

During the academic year the University Lecture Series brings to the campus a number of speakers eminent in national and international affairs, the sciences and the arts. In addition to their formal lectures, a number of these speakers meet with students informally for discussions. Through these lectures and discussions the students are given a well-rounded presentation on subjects and areas affecting their culture, educational and economic philosophy, and scientific development. A World Affairs Institute, concentrating on one aspect of international interest and drawing on experts in the field, and a National Affairs Institute, concerned with a topic of current interest in the United States, are held each year. From time to time University Lecture Series also sponsors or cosponsors dramatic, dance, and musical events.

DEBATE AND FORENSICS

Iowa State Debaters participate in several kinds of forensic activities. In addition to intramural and intercollegiate debate, they sponsor oratory, extemporaneous speaking, radio and television discussions, and provide service to business, professional, and educational organizations. Each year the Debaters travel some 30,000 miles to attend approximately 30 intercollegiate speech tournaments, participating in something over 400 debates annually. They sponsor both high school and collegiate speech tournaments each year. The University is a member of the Iowa Intercollegiate Forensic Association, Missouri Valley Forensic League, and has a chapter of Delta Sigma Rho-Tau Kappa Alpha, national forensics honorary. Participation in forensics is open to all students, with or without previous experience.

MUSIC ACTIVITIES

An opportunity to enjoy music, as both a listener and a performer, is provided all Iowa State students. The Department of Music offers a full instructional program in vocal and instrumental music, theory, history and literature, and music education. Large student performing organizations include three choruses, three bands, and a symphony orchestra. Smaller student
ensembles include the chamber singers, a pop chorus, and a stage band. Campus concerts, student operas, musical shows, concert tours, and a Christmas Festival of Music are among the musical events offered yearly.

Two concert series bring professional performers of high caliber to the campus and the city of Ames. Choral groups, orchestras, opera, ballet, and solo artists are presented. In addition, a series of concerts and recitals is given each year by members of the music faculty. These include programs by artist members of the Amati Trio, a piano trio in residence at the University.

Radio and television shows periodically feature student and faculty performers.

Sigma Alpha Iota and Phi Mu Alpha, professional music fraternities for women and men, are represented on campus.

**DRAMATICS**

Iowa State Theatre includes the Iowa State Players, who present well-known plays, and the Laboratory Theatre, which seeks unusual and lesser-known plays for specific laboratory purposes. Six to eight plays per year are presented.

The Theatre presents a series of 15 films, including unusual American films that are part of film history, and the unusual and best of the foreign films.

Another Theatre-sponsored program is Theatre 324, in which students direct the plays.

Professional productions are brought to campus by the Theatre in cooperation with the Lecture Committee.

Every summer ISU Theatre sponsors a summer theatre program, such as the current Showboat Players.
ATHLETICS

Iowa State is a member of the Big Eight Conference, which includes the University of Nebraska, University of Colorado, University of Kansas, Kansas State University, University of Oklahoma, Oklahoma State University, and the University of Missouri. Teams are fielded by Iowa State in football, basketball, baseball, wrestling, swimming, track, cross country, golf, tennis, and gymnastics.

One of the most extensive intramural programs in the nation allows undergraduates to compete among themselves as representatives of residence groups. Men compete in touch football, basketball, softball, volleyball, bowling, swimming, track, table tennis, wrestling, pocket billiards, golf, and tennis. Women compete in volleyball, basketball, softball, badminton, tennis, table tennis, golf, bowling, and swimming. Students may play the 18-hole Veenker Memorial Golf Course, part of the campus recreation area, at a nominal greens fee. Twenty-nine tennis courts are available.

SPECIAL RECOGNITIONS

The Deans' List, issued at the close of each quarter, recognizes undergraduate students who have been enrolled for 15 or more hours during the quarter and have earned a quality-point average of 3.5 or higher.

Undergraduate students who have an average of 3.5 or above for all work taken in the University are graduated "with distinction."

Many special awards, established by professional groups, alumni, and others interested in the University, are presented annually in recognition of academic attainment and noteworthy achievements in other areas of campus life. Information about awards offered in the various colleges is available through the offices of the respective deans.

INDEPENDENT STUDENT ASSOCIATION

The Independent Student Association is an organization of men and women living outside residence halls, fraternities, and sororities. Its purpose is to serve the interests of all students living off campus and to offer them an opportunity to participate in social activities, intramural sports, and various campus activities. Its representatives serve on the Government of the Student Body. Both within the campus organization and through the National Independent Student Organization, the Independent Student Association provides the opportunity for its members to develop their own leadership capabilities.
MEMORIAL UNION

The Memorial Union is the center of much informal education on campus. It is a meeting place and headquarters for most of the larger student organizations. Dances, banquets, lectures, concerts, shows, exhibits, and other large campus gatherings are accommodated in its meeting halls and ballrooms. Recreational facilities include bowling alleys, table tennis, billiards, television, and a music listening room, as well as quiet lounges and a browsing library. A small chapel occupies one corner of the building. A cafeteria, private dining rooms, a restaurant, and a snack bar cater to guests of the University as well as students and faculty. Overnight guest rooms are occupied by campus visitors. A bookstore meets nearly every student need.

Launched by alumni as a memorial to the service of sons and daughters of the University in World War I, Memorial Union has now become a memorial to all Iowa State men and women who have served in the armed forces of our country.

Acquisition cost of the building was nearly $4.5 million. The Memorial Union is owned and operated by students and alumni of Iowa State and is financed from dues and from fees received from services.

HONOR AND PROFESSIONAL ORGANIZATIONS

Ten honor societies, which elect membership primarily on attainment in scholarship or research, are recognized by the University:

- Alpha Kappa Delta—Sociology
- Alpha Lambda Delta—Freshmen (women)
- Alpha Zeta—Agriculture and Veterinary Medicine (men)
- Gamma Sigma Delta—Agriculture and Veterinary Medicine
- Omicron Nu—Home Economics (women)
- Phi Eta Sigma—Freshmen (men)
- Phi Kappa Phi—All-University
- Phi Zeta—Veterinary Medicine
- Sigma Xi—Scientific research
- Tau Beta Pi—Engineering (men)

Professional societies that choose their membership from students having special departmental affiliations and meeting scholastic and character requirements are officially recognized in most curricula of the University. There are also departmental clubs and organizations that meet special interests.

In addition, activities honoraries focus their requirements on the basis of interest, participation, or special attainment in all-University activities. Cardinal Key and Mortar Board are the highest activities honoraries for men and women respectively. Both select members on leadership, service to Iowa State, scholarship, and character.

Seven other activities honoraries recognize students in various special areas.

PUBLICATIONS

Student publications cover all facets of student life. They include:

The Bomb—Student yearbook
The Iowa State Daily—Campus newspaper
The Ames Forester—For forestry students and alumni
The Iowa Agriculturist—Published by students of the College of Agriculture
Outlook—Published by students of the College of Home Economics
The Iowa State University Veterinarian—Official publication of the student chapter of the American Veterinary Medical Association
The Iowa Engineer—Published by students of the College of Engineering
Ethos—Published by students of the College of Sciences and Humanities
Sketch—Publishes creative writing of students
Three Quarters—Publishes best writings of freshmen English students
FRATERNITIES AND SORORITIES

All social fraternities and sororities are under the coordination of the Dean of Students Office. Several staff members work through Interfraternity Council and Panhellenic Council to provide opportunities for self-development of students in these residence groups.

The 36 social fraternities with chapters at Iowa State have approximately 2,400 men and house about 2,000 of these. The cost of living in a fraternity house varies from $270 to $340 per quarter, with an average of $310. This amount includes room, board, social dues, and other chapter expenses. Initiation fees range from $20 to $117.50 per member, with an average cost of $80. The higher fees generally include the cost of the fraternity pin. First-year men students may live in a fraternity house.

There are approximately 950 women in the 14 national social sororities. The house bill for each member of these chapters ranges from $297 to $375 per quarter, with an average cost of approximately $330. This amount includes room, board, social and national dues, other chapter expenses, and in some cases, the building fund payment. Initiation fees vary from $24 to $95. The higher figure may include the cost of the active's pin or "badge," building fund payment, and lifetime membership.

Freshman women pledged during formal rush or later in the year are urged to live in the residence halls for the academic year. However, both they and upperclass women may move into their sorority house before or after initiation upon invitation of the chapter, providing they abide by their residence hall contracts.

Any woman admitted to Iowa State is eligible to go through rush. There is no grade requirement.

To be eligible for going through fraternity rush, a freshman entering Iowa State University without previous college credit must either rank in the upper one-half of his high school class on graduation or rank in the upper one-half of his high school class when admitted to Iowa State University.

RESIDENCE HALLS ASSOCIATIONS

Approximately 7,800 undergraduates live in the residence halls of Iowa State University. These residence halls are organized geographically into three autonomous student associations: the Towers Residence Association (TRA), the Richardson Court Association (RCA), and the Union Drive Association (UDA). The approximately 2,600 students in each of these coeducational associations elect a group of executive officers who are responsible for coordinating University events and activities with the association residence hall program. In addition, each association funds and maintains a social program, an intramural program, a camera club, a ham radio club, and numerous committees that supplement the total social-educational development of the individual residents. The three associations also jointly sponsor several projects such as the KPGY AM-FM radio station and Residence Hall Week.

Each association is further organized into smaller living groups called houses. These houses of 40 to 60 members are the foundation of Iowa State’s residence hall program. Members of the houses elect their own officers, and the majority of all programs are planned on a house-participation basis. The individual's educational experience is augmented by active participation in the total house program.
Alumni Activities

ALUMNI ASSOCIATION

Robert L. Crom, Ph.D., Director of Alumni Affairs

Those who have at some time been enrolled at Iowa State University are eligible for membership in the nonprofit charitable corporation known as the Iowa State University Alumni Association. It was organized in 1878 "to promote the social, moral, and material welfare" of Iowa State and of its faculty, graduates, and those currently or formerly enrolled.

Students are encouraged to become familiar with and use the services of the Association and to become involved in it upon completion of their work on campus.

The Association now serves more than 70,000 living alumni of record. Its offices are in the Memorial Union. Active local alumni clubs are found in many of the principal cities of the United States and in various counties of Iowa. The Alumnus, official periodical of the Association, is published bimonthly.

ALUMNI ACHIEVEMENT FUND

Don F. Gustofson, B.S., Director

The Alumni Achievement Fund supports many worthwhile causes for which other funds are not available. These include cultural activities, undergraduate research, awards for distinguished professors and undergraduates, intercollegiate athletics, scholarships, loan funds, and many needs of an emergency nature.

Funds for the support of these causes come from annual gifts from thousands of former students, graduates, and individual and corporate friends of the University. The Fund is often the recipient of major gifts in the form of real estate or securities. All gifts to the Fund are tax deductible. It is administered by a board of 15 trustees elected by the Alumni Association Executive Committee.

THE IOWA STATE UNIVERSITY FOUNDATION

Richard A. Morton, B.A., Executive Secretary

The Iowa State University Foundation was formed in 1958 to assist the University in projects which are vital to its growth and development, but which cannot or should not be financed from legislative appropriations. The Foundation is able to accept large gifts and grants from individuals or organizations and to assure continuity of management of such funds. Its board of 78 governors, mostly alumni, represents all areas of the nation.
Bachelor's Degree Requirements

A cumulative average of at least 2.00 in all work taken at Iowa State University is required for graduation.

A student transferring from another college or university to Iowa State is required to have a 2.00 cumulative average. A student may, however, be admitted with a quality point deficiency, but he will be required to earn enough quality points above a 2.00 at Iowa State to offset the quality-point deficiency at the time of entrance.

A student who takes work at another college or university after having been admitted to Iowa State is required to submit transcripts of all work taken elsewhere upon registration at Iowa State. This work must average a 2.00 or the deficiency of quality points will be assessed against the student. Failure to submit such transcripts will be grounds for dismissal.

In unusual circumstances, the academic standards committees of the respective colleges may review and give further consideration to the records of students who, except for grade-point average, have satisfactorily completed all graduation requirements. If the appropriate college academic standards committee considers that the educational and professional needs of such a student have been satisfactorily met, or can be satisfactorily met by imposing further conditions, then the committee may recommend to the dean of the college that the student be graduated or that a supplemental program be accepted in place of the fully unqualified grade-point average. The college academic standards committee chairman reports such exceptional actions to the University Academic Standards Committee.

High scholarship is recognized at graduation. Students who have a cumulative quality-point average of 3.50 or above are eligible to graduate with distinction. The quality-point average upon which graduation with distinction is determined includes all work undertaken at Iowa State prior to the opening of the quarter in which the student receives his degree.

The last 45 quarter credits needed to complete the requirements for a bachelor's degree must be taken in residence. However, nine of these last 45 quarter credits may be taken out of residence if in elective courses.

A student may receive two bachelor's degrees if he meets the requirements of each curriculum and earns at least 45 credits beyond the requirements of the curriculum requiring the greater number of credits. Each degree program must be approved by the appropriate department chairman or head.

ENGLISH PROFICIENCY REQUIREMENT

Students who have taken a first year English sequence and received no mark lower than a "C" and students whose native language is something other than English are not subject to the English proficiency requirement. The remainder must take the examination during the first quarter of the junior year. Those who fail the junior-level proficiency examination in English will be assigned to the Writing Clinic by their academic advisers. The student's major department will stipulate further procedures after receiving advice from the Clinic. Procedures may include the following: (a) sustained study in the Writing Clinic, (b) private tutoring, (c) written reports within the major department. The Writing Clinic will give descriptive reports to the student's department but will not issue pass-fail evaluations. The major department will be the final judge of the student's readiness to graduate.
LIBRARY REQUIREMENT

Independent study and investigation through the use of books and libraries enable students to grow intellectually and professionally in college and afterward. For this reason, all students receive instruction in the use of the University Library, including practice in how to locate the published literature of their respective fields of study.

PHYSICAL EDUCATION REQUIREMENT

Every undergraduate student must earn at least 3 credits in the basic instruction program in physical education unless he is certified by the Student Health Service as physically unfit to participate in the program or is specially excused from the requirement by the dean of his college.

Students are encouraged to go beyond this minimum requirement, which is normally met during the freshman year, and to follow a continuing program of physical activity throughout their stay at the University. As many as three additional credits in basic physical education courses may be counted among any unrestricted electives that are permitted in a student's curriculum. All students may also participate in the extensive intramural sports program of the University.
GRADING SYSTEM

For each credit earned, quality points are given according to the grade attained:

- A: 4 points
- B: 3 points
- C: 2 points
- D: 1 point
- F: 0 points
- P: Pass

Grade reports are prepared each quarter and are supplied to students. Grade reports are not routinely sent to parents but are made available upon their request.

For more detailed information see The Chart, the student handbook.

SATISFACTORY ACADEMIC PROGRESS

Minimum satisfactory scholastic achievement is represented by a 2.00 quality-point average each quarter of enrollment. Although failure to achieve this average is not cause for immediate dismissal, a student whose work is not satisfactory over a period of time is placed on temporary enrollment or may be dismissed in accordance with the regulations prescribed by the University Academic Standards Committee and the academic standards committee of the college in which he is enrolled.

CLASS ATTENDANCE

Students are expected to attend class periods as scheduled. An excuse for any class period missed is a matter between the student and his instructor.

STUDENT CONDUCT

It is expected that all Iowa State students are on campus for serious educational pursuits and that they will conduct themselves so as to preserve an appropriate atmosphere of learning. It is also expected that all students who enroll at Iowa State are willing to assume the responsibilities of citizenship in the campus community. Association in such a community is purely voluntary, and any student may withdraw from it at any time that he considers the obligations of membership disproportionate to the benefits. While enrolled, students are subject to University authority, which includes the prerogative of dismissing those whose conduct is unsuited to the aims of an institution of higher learning.

The President has delegated the authority to establish policy and to deal directly with discipline cases to the Committee on Student Behavior. See The Chart, the student handbook.

MOTOR VEHICLES

Students are permitted to own and operate motor vehicles—automobiles, motor scooters, and cycles. Motor vehicles, however, are in no way necessary for an Iowa State student, and the University believes students under 21 years of age will find it to their best interests not to operate an automobile in Ames. Those who operate a motor vehicle must abide by the rather extensive regulations necessary because of the congestion on campus. Fines are levied for infractions of the regulations.

PASS-NOT PASS

A limited number of courses may be elected under the Pass-Not Pass system. For the regulations regarding this system, see The Chart, the student handbook.
Students graduating from the College of Agriculture are provided with a broad education including the physical, biological and social sciences, and humanities. Only enough specialization is provided to help the graduate become established in his chosen profession. Greater specialization is provided at the graduate college level.

Graduates generally enter one of five broad areas (1) graduate studies, (2) education, (3) agricultural production, (4) business and industry, or (5) public agencies. Several curricula provide minors so that the specialization developed in the curriculum is designed for entry in one of these five areas.

Agriculture includes a broad range of career opportunities and hundreds of different kinds of jobs. The following list suggests some of the opportunities.

Farming and related enterprises such as raising fruits and vegetables, producing greenhouse and nursery stock, and growing timber or woodlands.

Research in agriculture, in government agencies, universities, industry, or private research organizations.

Education, including high school and college teaching, the Cooperative Extension Service, farm organizations, foundations, industry, and government agencies.

Industry, such as food processing, forest products, feed and fertilizer, farm machinery, fats and oils, pesticides and herbicides.

Business associated with agriculture—farm management, credit, insurance, food products, marketing, farm service and supply.

Special services, including landscape design, turfgrass management, establishment of parks and playgrounds, and urban planning.

Communications, as represented by agricultural magazines and journals, farm radio and television programs, motion pictures, exhibits, advertising, and public relations.

Forestry, soil and water conservation, fish and wildlife management, and outdoor recreation programs.

Each student in the College of Agriculture works closely with an academic adviser who is associated with the curriculum in which the student is majoring. The adviser helps the student prepare his schedule of courses each quarter, assists in making personal adjustment to university life, and counsels on vocational choices. A special effort is made in the College of Agriculture to adjust the student’s schedule of course work in accordance with his capabilities.

In addition to studies required for professional competence, the College of Agriculture provides in each of its curricula the opportunity to pursue studies which add to personal growth, help the individual to understand the environment in which he lives and aid him in communicating clearly. Requirements in any 4-year curriculum are at least as extensive as those shown in the group requirements.
Group Requirements, College of Agriculture

I. English and speech

II. Mathematical sciences
   (Computer science, mathematics, statistics)

III. Physical sciences
   (Biochemistry, biophysics, chemistry, geology, meteorology, and physics) Up to 5 credits in mathematics above the departmental mathematical requirement may be substituted for physical sciences.

IV. Biological sciences
   (Bacteriology, biochemistry, biology, biophysics, botany, genetics, zoology)

V. Social sciences
   (Anthropology, economics, government, psychology, sociology)

VI. Humanities
   (Art, foreign languages at the 200 level or above, history, literature, music, philosophy)

Credits

Most undergraduate study in the College of Agriculture covers a period of 4 years and leads to the degree Bachelor of Science, but shorter programs are also available. Graduate study in agriculture is conducted through the Graduate College. Details are found in the Graduate College section of the catalog.
Curricula in Agriculture

Leading to the Degree Bachelor of Science

Curriculum or Major
- Agricultural Business
- Agricultural Education
- Agricultural Engineering
- Agricultural Journalism
- Agronomy
- Animal Science
- Biometry
- Dairy Science
- Entomology
- Farm Operation
- Fisheries and Wildlife Biology
- Food Technology
- Forestry
  - Forest Resource Management
  - Forest Products
- Horticulture
- Landscape Architecture
- Outdoor Recreation Resources
- Plant Pathology
- Public Service and Administration in Agriculture
- Urban Planning

Department
- Economics
- Agricultural Education
- Agricultural Engineering
- Journalism and Mass Communication
- Agronomy
- Animal Science
- Statistics
- Animal Science
- Zoology and Entomology
- College of Agriculture
- Zoology and Entomology
- Food Technology
- Forestry
- Horticulture
- Landscape Architecture
- College of Agriculture
- Botany and Plant Pathology
- Sociology and Anthropology
- Landscape Architecture

Leading to a Certificate in Technical Agriculture

A 2-year program in agriculture administered through the office of Farm Operation. (See Index)

Curriculum in Agricultural Business

Administered by the Department of Economics.

Leading to the degree Bachelor of Science. Total credits required—192, including 3 credits of physical education.

Students majoring in agricultural business complete the core course requirements listed below, plus one or two minors. The core course requirements meet the College of Agriculture group requirements, provide the student with a broad educational background, and constitute a major in agricultural business. One minor must be selected from the following list:

Economic Analysis: For students interested in positions as professional agricultural economists in industry or government and for students interested in pursuing graduate work.

Farm Management: For students interested in farming, professional farm management, farm real estate, appraisal, extension, farm credit and banking, and other advisory services to farmers.

Marketing Management: For students interested in entering the various agricultural marketing, processing, distributive, and farm-supply businesses which serve agriculture. Specific work may involve sales, management, credit, banking, accounting, transportation, insurance, or personnel.

Public Policy: For students interested in positions with public agencies such as federal, state, and local governments, extension work, foreign agricultural services, and other organizations serving the public which require a basic knowledge of the business side of agriculture.
Agricultural Journalism: For students interested in agricultural journalism and mass communication. Students may select an area of concentration in advertising management and public relations, news and editorial writing, or radio and television broadcasting. Programs are developed in cooperation with the Department of Journalism and Mass Communication.

Agricultural Education: For students desiring to become certified to teach agricultural economics or vocational agriculture at the secondary school level. Programs are developed in cooperation with the Department of Agricultural Education.

A second minor may be selected from the above list or in departmental areas such as agricultural engineering, agronomy, animal science, and statistics. Specific courses are determined by the agricultural business curriculum in cooperation with the appropriate department. Minors contain 20 or more credits and must be declared prior to senior classification. Each major-minor program provides for electives to permit the student to select additional courses.
## Core Courses for a Major in Agricultural Business:

### Freshman Year

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<tr>
<td><strong>WINTER QUARTER</strong></td>
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<td>Principles of Crop Production</td>
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### Sophomore Year

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### Notes

1. Students are placed in Chem 140, 141, or 142 and Math. 104, 105, 109 or 110 consistent with preparation.
2. See group requirements for the College of Agriculture for a description of physical science and humanities.

Prior to graduation each student is required to complete the requirement for Ag. 104 (6 months of work experience). Students electing ROTC may apply these credits toward elective requirements.
Curriculum in Agricultural Education

Leading to the degree Bachelor of Science. Total credits required—192, including 3 credits of physical education.

Two calendar years of farm experience after the age of 14 are required of those who wish to qualify for teaching vocational agriculture.

The curriculum in agricultural education is designed to prepare persons for careers as vocational agriculture instructors, agricultural extension workers, or educational personnel in related agricultural businesses and industries.

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<td>Engl. 105</td>
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<td>An. S. 114</td>
<td>Psych 101</td>
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<td>Metal Construction and Maintenance</td>
<td>Publicity and Public Relations</td>
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<td>Orientation</td>
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</table>

Sophomore Year

| Econ. 241 | Econ. 242 | Chem. 231, 232 | 5 |
| General Chemistry | General Chemistry | American Government | 3 |
| Chem. 141, 142L | Chem. 142, 142L | Pol. S. 215 | 3 |
| Agricultural Engineering Elective | Fundamentals of Soil Science | Crop Growth and Culture |
| Biological Science Elective | Agron. 154A | Agron. 315 | 4 |
| | Developmental Psychology | Observation and Survey of Program |
| | Psych. 230 | of Education in Agriculture | 3 |
| | Animal Science Elective | Ag.Ed. 211A | 1 |

Junior and Senior Years

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<thead>
<tr>
<th>Technical Agriculture</th>
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<td>Agron. 354</td>
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<td>Humanities</td>
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<td>Electives in Art, History, Literature, Music, and Philosophy Electives</td>
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<td>An. S. 319</td>
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<td>Econ. 290</td>
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<td>Econ. 330</td>
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<tr>
<td>Electives in Technical Agriculture</td>
<td>17</td>
<td></td>
</tr>
</tbody>
</table>

In addition to the courses listed, each student will be required to include Ag.Ed. 110 and Ag. 104 in his freshman year. Students electing ROTC may apply these credits toward elective requirements.
The junior and senior years will cover a minimum of 96 credits and will be planned to carry forward and expand the field of the student's major study. A foundational or advanced systematic sequence of science or social studies may be chosen for the student's minor, non-agricultural teaching field. Early in the junior year, a complete program will be worked out by the student in conference with his adviser. The subjects making up the junior-senior years ordinarily should be 300- or 400-level courses.

To be certified and be a teacher in a specialized area of agriculture at the secondary school level, a student may earn 81 credits in technical agriculture, including 36 credits in one area of specialization, 20 credits in a second area of specialization in lieu of the technical agriculture requirements described above, and Psych. 101, 230, 333, Educ. 204, 305A, 305B, 426, and Ag. Ed. 110, 211A, 321, 412, 414, and 417.

Areas of specialization are agricultural economics, agricultural engineering, agronomy, animal science, and horticulture.

Students who do not meet the requirements for a teaching certificate may elect 18 credits in place of Ag. Ed. 412, 414, 417, and Educ. 426 and may be graduated with the degree Bachelor of Science in general agriculture.

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Curriculum in Agricultural Journalism

Administered by the Department of Journalism and Mass Communication.

Leading to the degree Bachelor of Science. Total credits required—198, including 3 credits of physical education and 6 credits of professional work requirement, Jl. 490J. To insure breadth of educational experience, and to provide professional competence in the field of journalism or as a foundation for graduate work, each student must complete credits in the basic areas of learning outlined below as a prerequisite to graduation.

<table>
<thead>
<tr>
<th>FALL QUARTER</th>
<th>WINTER QUARTER</th>
<th>SPRING QUARTER</th>
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<tbody>
<tr>
<td>Credits</td>
<td>Credits</td>
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**Freshman Year**

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<th>Language in Composition and Reading</th>
<th>Fundamentals of Speech</th>
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<td>Reading</td>
<td>Stat. 101 (5 cr.)</td>
<td>Introduction to Mass Communication</td>
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<td>Reading</td>
<td>or</td>
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<td>Reading</td>
<td>Chem. 141, 141L</td>
<td>Fundamentals of Soil Science</td>
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<tr>
<td>Principles of Biology</td>
<td>Principles of Crop Production</td>
<td>Agron. 154A</td>
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<td>Biol. 101</td>
<td>Agron. 114A</td>
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<td>Library Instruction</td>
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<td>Physical Education</td>
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Sophomore Year

Animal Production 5  Feeds and Feeding 4  American Government 3
An S 114  An S 218*  Pol. S. 215  3
Biology of Organisms 2  Environmental Biology 3  Principles of Economics 3
Biol 102A  Biol. 103  Econ 242  3
Basic Reporting 4  Principles of Economics 3  History of American Agriculture 3
Jl 201  Econ 241  Hist 375  3
Introduction to Sociology 3  Basic Reporting 4  Electives*  3
Soc 134  Jl 202  Jl 203  3
Electives 3  Electives 3

*Students seeking a subject matter concentration in the animal sciences are encouraged to include Chem 231 in the physical science group and substitute An S 318 for An S 218 in the agricultural group.

'\n
May be used as free electives or to fulfill group requirements (see junior-senior listing below)

Junior and Senior Years

Written and spoken English. 6 additional elective credits

Physical sciences: 8 additional elective credits in meteorology, geology, chemistry, or physics

Social sciences and humanities: 6 additional elective credits

Agriculture. Area of concentration in agriculture and related subject matter. 18 additional credits

Journalism: Four 300-level courses and three 400-level courses, plus 6 credits in Jl 490J, the professional work requirement
Curriculum in Agronomy

Leading to the degree Bachelor of Science. Total credits required—192, of which 58 to 63 are elective.

Students majoring in agronomy prepare for careers in soil science, crop science, and agricultural climatology, as well as farming, fertilizer and agricultural chemicals, seed production, seed technology, or soil conservation.

The elective credits permit further specialization in areas of interest and, at the option of the student, may be used to develop minors. Minors are usually interdisciplinary and are directed by the agronomy adviser in consultation with the student and the staff of the department offering the minor. The following are examples of minors:

- Agricultural business
- Animal science
- International service
- Agricultural education
- Extension education
- Outdoor recreation
- Agricultural journalism
- Farm management
- Turfgrass management

### FALL QUARTER

| Orientation in Agronomy | Agron 110 | 1 |
| Principles of Crop Production | Agron 114A | 4 |
| Principles of Biology | Biol. 101 | 3 |
| General Chemistry | Chem 141 and 141L(4 cr) | 4 |
| General Chemistry | Chem 147 and 147L(4 cr) | 4 |
| Language in Composition and Reading | Engl 104 | 4 |
| Physical Education | 1 |

### WINTER QUARTER

| Experimental Biology | Biol 101A | 2 |
| Language in Composition and Reading | Engl 105 | 4 |
| Library Instruction | Lib 160 | 3 |
| Finite Mathematics | Math 104(5 cr) | 4-5 |
| or | Introduction to Mathematical Ideas | Math 105(4 cr) | 4-5 |
| or | Analytic Geometry and Calculus I | Math 110(5 cr) | 4-5 |
| General Chemistry | Chem 142 and 142L(4 cr) | 4 |
| General Chemistry | Chem 148 and 148L(4 cr) | 4 |
| Physical Education | 1 |

### SPRING QUARTER

| Fundamentals of Soil Science | Agron 154A | 4 |
| Biology of Organisms | Biol 102B | 2 |
| Principles of Economics | Econ 241 | 3 |
| Introduction to Sociology | Soc 134(3 cr) | 3 |
| or | General Psychology | Psych 101(3 cr) | 3 |
| or | Physical Education | 1 |
| or | Elective | 3 |

### Sophomore Year

| General Botany | Bot. 107 | 5 |
| Fundamentals of Speech | Sp 211 | 3 |
| Elementary Organic Chemistry | Chem 231 and 232 (5 cr) | 5 |
| or | Organic Chemistry | Chem 334 (3 cr) | 3-5 |
| Electives | 3-5 |

| Plant Physiology | Bot. 310 | 4 |
| American Government | Pol S. 215 | 3 |
| Principles of Statistics | Stat 101 | 5 |
| Electives | 4 |

| Introduction to Meteorology | Agron 206 | 3 |
| Introductory Bacteriology | 3 |
| Foundations and Frontiers of Physics | 5 |
| or | General Physics | Phys. 111(4 cr) | 5 |
| or | Introduction to Classical Physics | Phys 221(5 cr.) | 4-5 |
| Electives | 3-4 |
### Curricula in Animal Science and Dairy Science

Leading to the degree Bachelor of Science. Total credits required—192, including 3 credits of physical education.

### Preprofessional Programs

Students interested in preparation for admission to colleges of law, medicine, or veterinary medicine may do so with a complementary program and may also satisfy requirements for the degree Bachelor of Science in animal science or Bachelor of Science in dairy science. (See Index)

### Minors

In addition to majoring in animal science or dairy science, a student may declare one or two minors. This declaration must be made prior to completion of 135 credits. Students declaring one minor must include at least 20 credits in the minor. Students declaring two minors must include at least 15 credits in each.

Suggested minors are: basic science, business, communications, education, extension service training, international service, plant sciences.

### Animal Science

**FALL QUARTER**

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**SPRING QUARTER**

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### Agronomic Sciences

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### Biological Sciences

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<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Survey of Biochemistry</td>
<td>3-4</td>
</tr>
<tr>
<td>B &amp; B 301 (3 cr)</td>
<td></td>
</tr>
<tr>
<td>or Fundamentals of Nutrition</td>
<td></td>
</tr>
<tr>
<td>An S 318 (4 cr)</td>
<td></td>
</tr>
<tr>
<td>Introductory Genetics</td>
<td>3</td>
</tr>
<tr>
<td>Gen. 301</td>
<td></td>
</tr>
</tbody>
</table>

### Social Sciences

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Three elective credits in economics, government,</td>
<td>3</td>
</tr>
<tr>
<td>psychology, or sociology</td>
<td></td>
</tr>
</tbody>
</table>

### Written and Spoken English

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Six elective credits in English, speech, or journalism</td>
<td>6</td>
</tr>
</tbody>
</table>

### Humanities

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Six elective credits in art, history, music, literature, or philosophy</td>
<td>6</td>
</tr>
</tbody>
</table>

Ag 104 (six months of work experience) is required before graduation.
### Fall Quarter

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anatomy of Domestic Animals</td>
<td>3</td>
</tr>
<tr>
<td>V. An. 217</td>
<td></td>
</tr>
<tr>
<td>Fundamentals of Soil Science</td>
<td>4</td>
</tr>
<tr>
<td>Agron. 154A</td>
<td></td>
</tr>
<tr>
<td>Communications Elective</td>
<td>3</td>
</tr>
<tr>
<td>Social Science Elective</td>
<td></td>
</tr>
</tbody>
</table>

### Winter Quarter

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical Science Elective</td>
<td></td>
</tr>
<tr>
<td>Animal Science Elective</td>
<td>3</td>
</tr>
<tr>
<td>Physiology of Domestic Animals</td>
<td></td>
</tr>
<tr>
<td>V Phys 264</td>
<td></td>
</tr>
<tr>
<td>Organic Chemistry</td>
<td>3</td>
</tr>
<tr>
<td>Communications Elective</td>
<td></td>
</tr>
<tr>
<td>Social Science Elective</td>
<td></td>
</tr>
<tr>
<td>Animal Science Elective</td>
<td>3</td>
</tr>
<tr>
<td>Communications Elective</td>
<td></td>
</tr>
</tbody>
</table>

### Spring Quarter

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anatomy of Domestic Animals</td>
<td>3</td>
</tr>
<tr>
<td>V. An. 217</td>
<td></td>
</tr>
<tr>
<td>Introduction in Animal Science</td>
<td>3</td>
</tr>
<tr>
<td>An. S. 110</td>
<td></td>
</tr>
<tr>
<td>Animal Production</td>
<td>3</td>
</tr>
<tr>
<td>An. S. 114</td>
<td></td>
</tr>
<tr>
<td>Language in Composition and Reading</td>
<td>3</td>
</tr>
<tr>
<td>Engl. 104</td>
<td></td>
</tr>
<tr>
<td>Physical Education</td>
<td>1</td>
</tr>
<tr>
<td>Library Instruction</td>
<td></td>
</tr>
<tr>
<td>Lib. 160</td>
<td></td>
</tr>
<tr>
<td>Physical Education</td>
<td></td>
</tr>
<tr>
<td>Basic Science</td>
<td>1</td>
</tr>
</tbody>
</table>

In addition to the courses in the core, each student is required to complete the following:

- Animal sciences (400 level) ... ... ... ... ... 12 credits
- Communications ... ... ... ... ... ... ... ... ... ... 9 credits
- Humanities ... ... ... ... ... ... ... ... ... ... ... 6 credits
- Physical sciences ... ... ... ... ... ... ... ... ... ... ... 3 credits
- Social sciences ... ... ... ... ... ... ... ... ... ... ... 12 credits

Credits for ROTC may apply toward elective credit.

1See curriculum credit sheet for specific information

### Dairy Science

### Fall Quarter

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Orientation in Animal Science</td>
<td>R</td>
</tr>
<tr>
<td>An. S. 110</td>
<td></td>
</tr>
<tr>
<td>Animal Production</td>
<td>5</td>
</tr>
<tr>
<td>An. S. 114</td>
<td></td>
</tr>
<tr>
<td>Language in Composition and Reading</td>
<td>4</td>
</tr>
<tr>
<td>Engl. 104</td>
<td></td>
</tr>
<tr>
<td>Physical Education</td>
<td>1</td>
</tr>
<tr>
<td>Library Instruction</td>
<td></td>
</tr>
<tr>
<td>Lib. 160</td>
<td></td>
</tr>
<tr>
<td>Physical Education</td>
<td></td>
</tr>
<tr>
<td>Basic Science</td>
<td></td>
</tr>
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</table>

### Winter Quarter

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introductory Food Technology</td>
<td>4</td>
</tr>
<tr>
<td>F. Tch. 114</td>
<td></td>
</tr>
<tr>
<td>Language in Composition and Reading</td>
<td>4</td>
</tr>
<tr>
<td>Engl. 105</td>
<td></td>
</tr>
<tr>
<td>Physical Education</td>
<td></td>
</tr>
<tr>
<td>Practical Work</td>
<td>4</td>
</tr>
<tr>
<td>Ag. 104</td>
<td></td>
</tr>
<tr>
<td>Basic Science</td>
<td></td>
</tr>
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</table>

### Spring Quarter

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Principles of Crop Production</td>
<td>4</td>
</tr>
<tr>
<td>Agron. 114A</td>
<td></td>
</tr>
<tr>
<td>Meat and Meat Processing</td>
<td>3</td>
</tr>
<tr>
<td>An. S. 170</td>
<td></td>
</tr>
<tr>
<td>Physical Education</td>
<td>1</td>
</tr>
<tr>
<td>Communications Elective</td>
<td></td>
</tr>
<tr>
<td>Basic Science</td>
<td></td>
</tr>
</tbody>
</table>

### Sophomore Year

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Principles of Economics</td>
<td>3</td>
</tr>
<tr>
<td>Econ. 241</td>
<td></td>
</tr>
<tr>
<td>Anatomy of Domestic Animals</td>
<td>3</td>
</tr>
<tr>
<td>V. An. 217</td>
<td></td>
</tr>
<tr>
<td>Social Science Elective</td>
<td>3</td>
</tr>
<tr>
<td>Animal Science Elective</td>
<td></td>
</tr>
<tr>
<td>Basic Science</td>
<td></td>
</tr>
</tbody>
</table>

### Summer Quarter

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>Principles of Economics</td>
<td>3</td>
</tr>
<tr>
<td>Econ. 242</td>
<td></td>
</tr>
<tr>
<td>Anatomy of Domestic Animals</td>
<td>3</td>
</tr>
<tr>
<td>V. An. 217</td>
<td></td>
</tr>
<tr>
<td>Social Science Elective</td>
<td>3</td>
</tr>
<tr>
<td>Animal Science Elective</td>
<td></td>
</tr>
<tr>
<td>Basic Science</td>
<td></td>
</tr>
</tbody>
</table>

### Junior Year

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introductory Genetics</td>
<td>3</td>
</tr>
<tr>
<td>Gen. 301</td>
<td></td>
</tr>
<tr>
<td>Fundamentals of Speech</td>
<td>3</td>
</tr>
<tr>
<td>Sp. 211</td>
<td></td>
</tr>
<tr>
<td>Animal Science Elective</td>
<td>3</td>
</tr>
<tr>
<td>Humanities Elective</td>
<td></td>
</tr>
</tbody>
</table>
Curriculum in Biometry

Administered by the Department of Statistics with the degree Bachelor of Science granted in the College of Agriculture. Total credits required—192, including 3 credits in physical education.

The major in biometry is expected to include the statistics and mathematics courses indicated in the core requirements that follow. With the guidance of an advisory committee from agriculture, the student will select technical agriculture courses which will provide some depth of training in an agriculturally related area, such as agronomy, animal science, biology, entomology, fisheries and wildlife, food technology, forestry, or plant pathology.

Core Requirements

\begin{tabular}{llllll}
\hline
FALL QUARTER & WINTER QUARTER & SPRING QUARTER \\
Credits & Credits & Credits \\
\hline
Freshman Year & & & & & \\
Principles of Crop Production & Principles of Biology & Experimental Biology \\
Agron 114 & Biol. 101 & Biol. 101A \\
General Chemistry & General Chemistry & Animal Production \\
Chem. 141, 141L & Chem. 142, 142L & An. S. 114 \\
Language in Composition and Reading & Language in Composition and Reading & Analytic Geometry and Calculus I \\
Engl. 104 & Engl. 105 & Math. 110\textsuperscript{1} \\
Library Instruction & Introduction to Statistics & Introduction to Sociology \\
Lib. 160 & Stat. 104 & Soc. 134 \\
Physical Education & Physical Education & Physical Education \\
Orientation in Statistics & & \\
Stat. 100 & & \\
\hline
\end{tabular}

\textsuperscript{1}The required minimum 25-credit total in biology (101, 101A), mathematics (109 level or higher), chemistry (141, 141L, 142, 142L, and organic) and statistics (101) will be scheduled in a proper sequence in accordance with student's preparation and preference.

\textsuperscript{2}Eng. 215 is recommended.

\textsuperscript{3}Humanities include art, history, literature, music, or philosophy.

\textsuperscript{4}Five credits of mathematics at a level above the minimum requirement may be substituted for physical science.

\textsuperscript{5}ROTC credits may be used for electives.
### Sophomore Year

<table>
<thead>
<tr>
<th>FALL QUARTER</th>
<th>WINTER QUARTER</th>
<th>SPRING QUARTER</th>
</tr>
</thead>
<tbody>
<tr>
<td>Credits</td>
<td>Credits</td>
<td>Credits</td>
</tr>
<tr>
<td>Principles of Economics</td>
<td>3</td>
<td>Principles of Economics</td>
</tr>
<tr>
<td>Econ. 241</td>
<td>3</td>
<td>Econ. 242</td>
</tr>
<tr>
<td>Analytic Geometry and Calculus II</td>
<td>5</td>
<td>Analytic Geometry and Calculus III</td>
</tr>
<tr>
<td>Math. 111</td>
<td>5</td>
<td>Math. 112</td>
</tr>
<tr>
<td>General Physics</td>
<td>4</td>
<td>Fundamentals of Speech</td>
</tr>
<tr>
<td>Phys. 111</td>
<td>4</td>
<td>Sp. 211</td>
</tr>
<tr>
<td>Technical Agriculture</td>
<td>4</td>
<td>Biology Elective</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Technical Agriculture</td>
</tr>
</tbody>
</table>

In addition to the courses in the core, each student is required to complete Chem. 231, Stat. 341, 342, 343, 380, 401, 402, 411, 421, 482, and the following minimum elective credits:

- Statistics: 3 credits
- Humanities: 6 credits
- Technical Agriculture: 22 credits
- General Electives: 34 credits

Ag. 104 (six months of work experience) is required before graduation.

Students electing ROTC may apply these credits toward elective requirements.

Courses selected in mathematics should be consistent with preparation. (See Index, Mathematics for description of beginning courses.)

### Curriculum in Entomology

Administered by the Department of Zoology and Entomology.

Leading to the degree Bachelor of Science. Total credits required—192, including 3 credits of physical education.

<table>
<thead>
<tr>
<th>FALL QUARTER</th>
<th>WINTER QUARTER</th>
<th>SPRING QUARTER</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Credits</td>
<td>Credits</td>
</tr>
</tbody>
</table>

#### Freshman Year

<table>
<thead>
<tr>
<th>Principles of Biology</th>
<th>Environmental Biology</th>
<th>General Zoology</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biol. 101</td>
<td>Biol. 103</td>
<td>Zool. 106</td>
</tr>
<tr>
<td>Experimental Biology</td>
<td>General Chemistry</td>
<td>Gen. 107</td>
</tr>
<tr>
<td>Biol. 101A</td>
<td>Chem. 142, 142L</td>
<td>Bot. 107</td>
</tr>
<tr>
<td>General Chemistry</td>
<td>Principles of Statistics</td>
<td>Reading</td>
</tr>
<tr>
<td>Chem. 141, 141L</td>
<td>Stat. 101</td>
<td>Engl. 105</td>
</tr>
<tr>
<td>Finite Mathematics</td>
<td>Language in Composition and Reading</td>
<td>Library Instruction</td>
</tr>
<tr>
<td>Math. 104 (5 cr.)</td>
<td>Engl. 104</td>
<td>Lib. 160</td>
</tr>
<tr>
<td></td>
<td>Physical Education</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Precalculus Mathematics</td>
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</tr>
<tr>
<td>Math. 109 (5 cr.)</td>
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</tr>
<tr>
<td>Technical Lecture</td>
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<tr>
<td>Zool. 100</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Physical Education</td>
<td></td>
<td></td>
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<td></td>
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<td>1</td>
</tr>
</tbody>
</table>
Curriculum in Farm Operation

Administered by the College of Agriculture.

The curriculum offers work for the degree Bachelor of Science with major work in farm operation. It includes a collegiate winter quarter program, a 2-year program leading to a certificate in technical agriculture and a 4-year degree program.

The farm operation curriculum is intended for those students who are preparing to enter production agriculture and related occupations. It is, therefore, designed to help the student develop those understandings, abilities, and attitudes which are essential to efficient management of production resources. It also enables the student to become better prepared for participation as a citizen and leader in his community. Through the use of electives, students may develop an area of specialization to accompany their major in farm operation.

Winter Quarter Program

The farm operation winter-quarter collegiate program is provided for the student who wants a one-quarter practical agriculture program. Admission requirements are flexible for
students in this program, and all required courses will apply toward the degree Bachelor of Science if the student continues his education. In the event the student continues his work at Iowa State University, he may follow the two- or four-year farm operation curriculum or transfer to another curriculum.

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Farm Operation Orientation</td>
<td>R</td>
</tr>
<tr>
<td>Farm Machinery Management</td>
<td>A.E. 134</td>
</tr>
<tr>
<td>Agricultural Maintenance Welding</td>
<td>A.E. 154</td>
</tr>
<tr>
<td>Principles of Crop Production</td>
<td>Agron. 114B</td>
</tr>
<tr>
<td>Fundamentals of Soil Science</td>
<td>Agron. 154B</td>
</tr>
<tr>
<td>Animal Production</td>
<td>An.S. 114</td>
</tr>
<tr>
<td>Elements of Farm Management</td>
<td>Econ. 130</td>
</tr>
</tbody>
</table>

**Two-Year Program**

The two-year farm operation college credit program is designed for the student who wants to enter farming or related occupations and does not wish to obtain the degree Bachelor of Science. Emphasis in this program is on practical and applied agriculture. Students who satisfactorily complete at least 96 credits in the prescribed two-year program and have at least a 1.75 grade point will receive a certificate in technical agriculture.

<table>
<thead>
<tr>
<th>QUARTER</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>FALL QUARTER</strong></td>
<td></td>
</tr>
<tr>
<td>Animal Production</td>
<td>An.S. 114</td>
</tr>
<tr>
<td>Metal Construction and Maintenance</td>
<td>A.E. 254</td>
</tr>
<tr>
<td>Principles of Biology</td>
<td>Biol. 101</td>
</tr>
<tr>
<td>Language in Composition and Reading</td>
<td>Eng. 104</td>
</tr>
<tr>
<td>Physical Education</td>
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</tr>
<tr>
<td>Farm Operation Orientation</td>
<td>Ag. 110</td>
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</table>

<table>
<thead>
<tr>
<th>QUARTER</th>
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</tr>
</thead>
<tbody>
<tr>
<td><strong>WINTER QUARTER</strong></td>
<td></td>
</tr>
<tr>
<td>Principles of Crop Production</td>
<td>Agron. 114A</td>
</tr>
<tr>
<td>Agricultural Construction Materials and Procedures</td>
<td>A.E. 255</td>
</tr>
<tr>
<td>Mathematical Concepts</td>
<td>Math. 190</td>
</tr>
<tr>
<td>Language in Composition and Reading</td>
<td>Eng. 105</td>
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<td>Physical Education</td>
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</table>

<table>
<thead>
<tr>
<th>QUARTER</th>
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</tr>
</thead>
<tbody>
<tr>
<td><strong>SPRING QUARTER</strong></td>
<td></td>
</tr>
<tr>
<td>Animal Production</td>
<td>An.S. 170</td>
</tr>
<tr>
<td>Fundamentals of Soil Science</td>
<td>Agron. 154</td>
</tr>
<tr>
<td>Elements of Farm Management</td>
<td>Econ. 130</td>
</tr>
<tr>
<td>Fundamentals of Speech</td>
<td>Sp. 211</td>
</tr>
<tr>
<td>Farm Machinery Management</td>
<td>A.E. 134</td>
</tr>
<tr>
<td>Agricultural Engineering Elective</td>
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</tr>
<tr>
<td>Foundations of Chemistry</td>
<td>Chem. 140, 141L(4 cr.)</td>
</tr>
<tr>
<td>General Chemistry</td>
<td>Chem. 141, 141L(4 cr.)</td>
</tr>
<tr>
<td>Rural Institutions and Organizations</td>
<td>Soc. 130</td>
</tr>
<tr>
<td>Electives</td>
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</tr>
<tr>
<td>Physical Education</td>
<td></td>
</tr>
<tr>
<td>Practical Work</td>
<td>Ag. 104</td>
</tr>
<tr>
<td>Agronomy Elective</td>
<td></td>
</tr>
<tr>
<td>Engineering Problems in Livestock Management</td>
<td>A.E. 219</td>
</tr>
<tr>
<td>Farm Accounting and Business Analysis</td>
<td>Econ. 230</td>
</tr>
<tr>
<td>Electives</td>
<td></td>
</tr>
</tbody>
</table>

Students electing ROTC may apply these credits toward elective requirements.

1Any 100 or 200 level course.
Four-Year Major

Leading to the degree Bachelor of Science. Total credits required—192, including 3 credits of physical education.

Within the curriculum for the four-year farm operation major, a student may use his electives to develop an area of specialization. He may also select one or more minors which must be declared prior to the completion of 120 credits. Students declaring one minor are to include at least 20 credits in addition to curriculum requirements in the area of interest. Students who choose more than one minor are to include at least 15 credits in each area. Specific courses in each minor are determined by the farm operation staff in cooperation with the appropriate department.

Students who want to become certified to teach in a specialized area of agriculture or vocational agriculture at the secondary school level may minor in agricultural education. (See Agricultural Education.)

<table>
<thead>
<tr>
<th>FALL QUARTER</th>
<th>WINTER QUARTER</th>
<th>SPRING QUARTER</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Credits</strong></td>
<td><strong>Credits</strong></td>
<td><strong>Credits</strong></td>
</tr>
<tr>
<td><strong>Freshman Year</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Principles of Biology Biol. 101</td>
<td>Language in Composition and Reading Engl. 104</td>
<td>Language in Composition and Reading Engl. 105</td>
</tr>
<tr>
<td>Biology of Organisms Biol. 102A</td>
<td>Environmental Biology Biol. 103</td>
<td>Physical Education</td>
</tr>
<tr>
<td>Library Instruction Lib. 160</td>
<td>Biology of Organisms Biol. 102B</td>
<td>Agricultural Engineering Elective</td>
</tr>
<tr>
<td>Physical Education</td>
<td>Physical Education</td>
<td>Mathematics 1</td>
</tr>
<tr>
<td>Farm Operation Orientation Ag. 110</td>
<td>R</td>
<td></td>
</tr>
</tbody>
</table>

| **Sophomore Year** |             |                |
| General Chemistry Chem. 141, 141L | General Chemistry Chem. 142, 142L | Elementary Organic Chemistry Chem. 231, 232 |
| Principles of Economics Econ. 241 | Principles of Economics Econ. 242 | Fundamentals of Soil Science Agron. 154A |
| Farm Accounting and Business Analysis Econ. 230 (3 cr.) | Agricultural Engineering Elective Physical Science Elective | Social Sciences Elective 1 |
| or Principals of Accounting I.Ad. 384 (4 cr.) | R | |

| **Junior Year** |             |                |
| Fundamentals of Nutrition An. S. 318 | Statistics 1 | Agricultural Engineering Elective |
| Humanities Elective 2 | Social Sciences Elective 2 | 3 |
| Humanities Elective 2 | 3 | 3 |
# Curriculum in Fisheries and Wildlife Biology

Administered by the Fisheries and Wildlife Section, Department of Zoology and Entomology.

Leading to the degree Bachelor of Science. A minor in botany is recommended. Total credits required—192, including 3 credits of physical education.

<table>
<thead>
<tr>
<th>FALL QUARTER</th>
<th>WINTER QUARTER</th>
<th>SPRING QUARTER</th>
</tr>
</thead>
<tbody>
<tr>
<td>Credits</td>
<td>Credits</td>
<td>Credits</td>
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<table>
<thead>
<tr>
<th>Principles of Biology</th>
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<tbody>
<tr>
<td>Biol. 101</td>
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<td>Experimental Biology</td>
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<tr>
<td>Biol. 101A</td>
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<td>Chem. 142, 142L</td>
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<td>Chem. 141, 141L</td>
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<tr>
<td>Introduction to Sociology</td>
<td>3</td>
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<td>Soc. 134</td>
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<tr>
<td>Technical Lecture</td>
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<td>Finite Mathematics</td>
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<td>Math. 104 (5 cr.)</td>
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1. Eight credits total in mathematics and statistics. At least one course in each area.
2. Six credits total in humanities in these areas: art, history, literature, music, philosophy, anthropology, foreign languages.
3. Six credits selected from political science, sociology, psychology, economics other than agricultural economics.
4. Two or 3 credits selected from Engl. 304, 404, 414, Sp. 312, 317, 327, 332, Jl. 201, 225, 325.
### Colleges and Curricula

**FALL QUARTER**

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<thead>
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<td>General Zoology</td>
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<td>Zool. 106</td>
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<td>Mammalogy</td>
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<td>Geol 100</td>
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<td>Principles of Economics</td>
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<td>Comparative Anatomy</td>
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<td>Gen 301</td>
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<td>American Government</td>
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<td>Pol S. 215</td>
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<td>Sp 211</td>
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<td>Ichthyology</td>
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**WINTER QUARTER**

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<td>Bot. 424</td>
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<td>Publicity and Public Relations</td>
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<td>Jl. 225</td>
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<td>Invertebrate Zoology</td>
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<td>Zool 307</td>
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<tr>
<td>Fundamentals of Limnology</td>
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**SPRING QUARTER**

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<tr>
<td>Forest Conservation</td>
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<td>Vertebrate Embryology</td>
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<td>Zool 334</td>
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<td>Principles of Physiology</td>
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<td>Zool 455</td>
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<tr>
<td>Wildlife Techniques</td>
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<td>Zool 448</td>
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<tr>
<td>Soil and Water Management</td>
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<td>A E 306</td>
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</table>

Ag. 104 (six months of work or summer biological station experience) is required before graduation.

A minimum of nine credits must be elected in art, literature, history, and philosophy.

Other suggested electives: A E 371, Agron. 206, 364; Bot. 203, 310, 564, C E 211; Geol 201, 230, 431; Econ 434; Engl. 404; For. 101, 301, 447, Pol S 216, 471, 474; Psych. 101, Phys. 113, Jl. 317, Zool. 303, 306, 311, 349, 470, 501, 503, 540, 560, 571.

Students electing ROTC may apply 18 of these credits toward elective requirements.

Students preparing for graduate college should take for credit one year of a foreign language, a full year of physics, and additional chemistry and mathematics.

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### Curriculum in Food Technology

Leading to the degree Bachelor of Science. Total credits required—192.

Students may minor in science or business and have opportunities for specialization in various product areas. The science minor is designed for those interested in the applications of chemistry, bacteriology, and other sciences to food processing and preservation. The business minor is designed for those who wish to pursue careers in management and operation of food plants and food marketing.
<table>
<thead>
<tr>
<th>FALL QUARTER</th>
<th>WINTER QUARTER</th>
<th>SPRING QUARTER</th>
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<tbody>
<tr>
<td>Credits</td>
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<td>Credits</td>
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<tr>
<td>Language in Composition and Reading Engl. 104</td>
<td>Introductory Food Technology F.T.ch. 114</td>
<td>Principles of Biology Biol. 101</td>
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<td>Pre-calculus Mathematics Math. 109</td>
<td>Language in Composition and Reading Engl. 105</td>
<td>Experimental Biology Biol. 101A</td>
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<td>General Chemistry Chem. 141, 141L or 147, 147L</td>
<td>Intuitive Calculus Math. 161</td>
<td>Intuitive Biology Math. 162</td>
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<td>Library Instruction Lib. 160</td>
<td>General Chemistry Chem. 142, 142L or 148, 148L</td>
<td>Quantitative Analysis Chem. 211</td>
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<td>Technical Lectures F.T.ch. 110</td>
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<tr>
<td><strong>Sophomore Year</strong></td>
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<tr>
<td>Environmental Biology Biol. 103</td>
<td>Basic Food Industries F.T.ch. 202</td>
<td>Industrial Organization I.E. 351</td>
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<tr>
<td>or Chem. 334(3 cr.)</td>
<td>Food Chemistry F.T.ch. 450</td>
<td>Food, Milk and Water Sanitation F.T.ch. 450</td>
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<td>3-5</td>
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<td><strong>Junior Year</strong></td>
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<td>Food Chemistry F.T.ch. 449</td>
<td>General Physics Phys. 112</td>
<td>Principles of Economics Econ. 242</td>
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<td>Dairy Microbiology F.T.ch. 450</td>
<td>Principles of Economics Econ. 243</td>
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<tr>
<td>General Physics Phys. 111</td>
<td>Food Chemistry F.T.ch. 491</td>
<td>Food Preservation F.T.ch. 491</td>
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<td>Principles of Economics Econ. 241</td>
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<td><strong>Senior Year</strong></td>
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<td>Introduction to Food Processing Systems F.T.ch. 492</td>
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<td>Food-related Courses¹</td>
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</table>

Students minoring in science should take Chem. 334 rather than 231 and include in their electives additional courses in organic chemistry, physics, biochemistry, and biology.

Students minoring in business should include in their electives additional courses in economics, industrial administration, speech, and journalism.

Students receiving Institute of Food Technologists' scholarships must meet the curriculum standards adopted by the Institute of Food Technologists.

¹Students are required to take 18 credits in courses related to food technology besides those listed above. They may use these hours to broaden their knowledge of food technology or to specialize in a commodity area. Recommended courses are:

- **Dairy Technology:** F.T. 207, 305, 306, 307, 559
- **Meat Technology:** An.S: 170, 271, 370, 470
- **Poultry Technology:** An.S. 471
- **Horticulture:** Hort. 224, 264, 321, 414, 501
- **Nutrition:** An.S. 318; F.N. 107, 305
Curriculum in Forestry

With majors in forest resource management and forest products. Leading to the degree of Bachelor of Science. Total credits required—201, including 3 credits of physical education.

The forestry curriculum offers educational opportunities for students interested in positions of professional responsibility involving the management and administration of forest resources and their utilization.

### FALL QUARTER

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<tr>
<th>Course</th>
<th>Credits</th>
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<tbody>
<tr>
<td>Precalculus Mathematics, Math. 109</td>
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<td>Principles of Biology, Biol. 101</td>
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<tr>
<td>Experimental Biology, Biol. 101A</td>
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<td>General Chemistry, Chem. 141, 141L</td>
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<td>Library Instruction, Lib. 160</td>
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<td>Orientation, For. 110</td>
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<td>Physical Education</td>
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### WINTER QUARTER

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<tr>
<td>Introduction to Forest Resource Management</td>
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<tr>
<td>Language in Composition and Reading, Engl. 104</td>
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<tr>
<td>General Botany, Bot. 107</td>
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<td>Math. 161</td>
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### SPRING QUARTER

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<td>American Government, Pol.S. 215</td>
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<td>Wood Technology, For. 380</td>
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<td>Humanities</td>
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<td>intro to Statistics, Stat. 104</td>
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<td>Principles of Economics, Econ. 242</td>
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<td>Analytic Geometry and Calculus</td>
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<td>Computer Programming, Com.S. 201</td>
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<td>Fundamentals of Speech</td>
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<td>Sp. 211</td>
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<td>Forest Mensuration, For. 241</td>
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<td>Special Problems, Math. 490 (3 cr.)</td>
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### Freshman Year

Students who have not had high school chemistry should take Chem. 140, 140L

### Forest Resource Field Studies (Required)

The summer field studies program is conducted for six weeks during the summer between the freshman and sophomore years, and is prerequisite to admission to the junior year. The following courses are offered: Forest Ecology, For. 201, Cr 2, Wood Utilization, For. 202, Cr. 2, Forest Measurements, For. 203, Cr 3, Multiple Use Operations, For. 204, Cr. 2

### Sophomore Year

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<td>Organic Chemistry, Chem. 334 (3 cr.)</td>
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<td>Social Science</td>
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<td>Physics</td>
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<td>Introduction to Statistics</td>
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<td>Principles of Economics, Econ. 242</td>
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<td>American Government, Pol.S. 215</td>
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<td>Wood Technology, For. 380</td>
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<td>Computer Programming, Com.S. 201</td>
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<td>Sp. 211</td>
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<td>Linear Algebra, Math. 205 (3 cr.)</td>
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<td>Special Problems, Math. 490 (3 cr.)</td>
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### Forest Resource Management Major

#### FALL QUARTER

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<td>Bot. 256</td>
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#### Winter Quarter

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<td>For. 301</td>
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<td>Forest Soils</td>
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<td>Agron. 357</td>
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<tr>
<td>Plant Physiology</td>
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<td>Bot. 310</td>
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#### Spring Quarter

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<td>Economics and Management</td>
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<tr>
<td>For. 451</td>
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<td>Forest Management</td>
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<td>For. 397</td>
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<td>Forest Vegetation Manipulation</td>
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<td>For. 302</td>
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<td>Electives</td>
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</table>

In addition to the courses specified in the curriculum the student is required to include 6 credits in courses dealing with nontimber forest resources, social science, 6 credits, humanities, 9 credits, electives, 18 credits, a minor of 20 credits, and practical work (Ag. 104).

### Forest Products Major

#### Junior Year

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<td>Wood Liquid Relations</td>
<td>4</td>
</tr>
<tr>
<td>For. 386</td>
<td></td>
</tr>
<tr>
<td>Humanities</td>
<td>3</td>
</tr>
<tr>
<td>Minor or Physical Science</td>
<td>6</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemical Processing of Wood</td>
<td>4</td>
</tr>
<tr>
<td>For. 481</td>
<td></td>
</tr>
<tr>
<td>Minor or Physical Science</td>
<td>6</td>
</tr>
<tr>
<td>Electives</td>
<td>6</td>
</tr>
</tbody>
</table>

#### Senior Year

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Management of Forest Resources</td>
<td></td>
</tr>
<tr>
<td>Mechanical Processing of Wood</td>
<td>3</td>
</tr>
<tr>
<td>For. 487</td>
<td></td>
</tr>
<tr>
<td>Wood Composite Products</td>
<td>4</td>
</tr>
<tr>
<td>For. 485</td>
<td></td>
</tr>
<tr>
<td>Management of Forest Resources</td>
<td></td>
</tr>
<tr>
<td>Economics and Management</td>
<td>3</td>
</tr>
<tr>
<td>For. 451</td>
<td></td>
</tr>
</tbody>
</table>

In addition to the courses specified in the curriculum the student is required to include: physical science, 10 credits; social science, 6 credits, humanities, 9 credits, electives, 18 credits; a minor of 20 credits; and practical work (Ag. 104).
Minors

Each student is required to select one minor consistent with his major and his long-range professional objectives and interests. Minors in the forest management major consist of 20 credits. Those in the forest products major include 20 credits. Details on the composition and objectives of the various minors are available from advisers. Minors are designed either to supplement the student’s general professional education or to develop substantial preparation for graduate study. A minor does not qualify the graduate as a specialist in the area indicated.

Forest Management minors—20 credits

<table>
<thead>
<tr>
<th>Biological sciences</th>
<th>Forest range management</th>
</tr>
</thead>
<tbody>
<tr>
<td>Managerial sciences</td>
<td>Timber products</td>
</tr>
<tr>
<td>Resource education</td>
<td>Multiple purpose forestry</td>
</tr>
<tr>
<td>Forest biology</td>
<td>Forestry business</td>
</tr>
<tr>
<td>Forest recreation</td>
<td>Urban forestry</td>
</tr>
<tr>
<td></td>
<td>Forest soils</td>
</tr>
</tbody>
</table>

Forest Products minors—20 credits

<table>
<thead>
<tr>
<th>Wood science and technology</th>
<th>Timber products conversion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Timber products business</td>
<td></td>
</tr>
</tbody>
</table>

A student completing one of the three ROTC programs may apply up to 9 credits of air science, military science, or naval science courses toward his minor.

Curriculum in Horticulture

With business, science, teaching, or technical minors leading to the degree Bachelor of Science. Total credits required—192, including 3 credits of physical education.

Students in horticulture are required to select a minor in technical horticulture, horticultural business, horticultural science, or horticultural teaching. A faculty adviser will assist in selecting courses and arranging schedules.

<table>
<thead>
<tr>
<th>FALL QUARTER</th>
<th>WINTER QUARTER</th>
<th>SPRING QUARTER</th>
</tr>
</thead>
<tbody>
<tr>
<td>Credits</td>
<td>Credits</td>
<td>Credits</td>
</tr>
</tbody>
</table>

Freshman Year

<table>
<thead>
<tr>
<th>Principles of Biology</th>
<th>General Chemistry(^1)</th>
<th>Fundamentals of Soil Science</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biol. 101</td>
<td>Chem. 141, 141L</td>
<td>Agron. 154A</td>
</tr>
<tr>
<td>EXPERIMENTAL BIOLOGY</td>
<td>Language in Composition and Reading</td>
<td>General Botany</td>
</tr>
<tr>
<td>Biol. 101A</td>
<td>Engl. 105</td>
<td>Bot. 107</td>
</tr>
<tr>
<td>LANGUAGE IN COMPOSITION AND READING</td>
<td>Greenhouse Methods</td>
<td>4</td>
</tr>
<tr>
<td>Engl. 104</td>
<td>Hort. 154</td>
<td>General Chemistry</td>
</tr>
<tr>
<td>INTRODUCTION TO HORTICULTURE</td>
<td>General Zoology</td>
<td>Chem. 142, 142L</td>
</tr>
<tr>
<td>Hort. 110</td>
<td>Zool. 106</td>
<td>General Psychology</td>
</tr>
<tr>
<td>PRINCIPLES OF HORTICULTURE LABORATORY</td>
<td>Physical Education</td>
<td>Psych. 101</td>
</tr>
<tr>
<td>Hort. 114A</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>PRINCIPLES OF HORTICULTURE</td>
<td>1</td>
<td>Physical Education</td>
</tr>
<tr>
<td>Hort. 114B</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>LIBRARY INSTRUCTION</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Lib. 160</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>PHYSICAL EDUCATION</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>FALL QUARTER</td>
<td>WINTER QUARTER</td>
</tr>
<tr>
<td>---------------</td>
<td>--------------</td>
<td>----------------</td>
</tr>
<tr>
<td><strong>Sophomore Year</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Finite Mathematics</td>
<td>Math. 104</td>
<td>Principles of Economics</td>
</tr>
<tr>
<td>Foundations and Frontiers of Physics</td>
<td>Phys. 101</td>
<td>Plant Propagation</td>
</tr>
<tr>
<td>Elective and Minor Credits</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td><strong>Junior Year</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Applied Entomology</td>
<td>Zool. 376</td>
<td>Crop Growth and Culture</td>
</tr>
<tr>
<td>Elective and Minor Credits</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td></td>
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<tr>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Senior Year</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Seminar</td>
<td>Hort. 401</td>
<td>Principles of Plant Pathology</td>
</tr>
<tr>
<td>Humanities</td>
<td>3</td>
<td>Seminar</td>
</tr>
<tr>
<td>Elective and Minor Credits</td>
<td>12</td>
<td>Elective and Minor Credits</td>
</tr>
</tbody>
</table>
| Ag. 104 (six months of work experience) is required before graduation.

1 Students who have not had high school chemistry must take Chem. 140, 140L.
2 Humanities include art, history, literature, music, and philosophy.

**MINORS**

Specific minors may be elected in business, science, teaching and technical specialties. Suggested course requirements for minors are available in the Department of Horticulture. All final programs are arrived at through student-adviser consultation.

**Business Minor**

The business minor includes additional education in economics and industrial administration and is intended to provide the student with a broad understanding of business operations and management.

**Science Minor**

The science minor provides additional education in chemistry, physics, and mathematics, and is designed primarily for students planning graduate study.

**Teaching Minor**

Students may qualify for a professional secondary teaching certificate to teach vocational agriculture with a specialization in horticulture. To be certified, students are required to earn 81 credits in technical agriculture. Specific requirements include 36 credits
in horticulture, 20 credits in a second area of specialization, and 25 credits in related technical agriculture courses. Students seeking certification must apply for admission to the teacher education program in agricultural education at the end of their sophomore year and maintain a minimum average of 2.3 for graduation.

**Technical Minor**

The technical minor places emphasis on production-oriented horticulture. Students may elect to specialize in general horticulture, floriculture, ornamentals, fruit crops, vegetable crops, nursery management, or turf management.

**Curriculum in Landscape Architecture**

Leading to the degree Bachelor of Science. Total credits required—192, including 3 credits of physical education.

<table>
<thead>
<tr>
<th>FALL QUARTER</th>
<th>WINTER QUARTER</th>
<th>SPRING QUARTER</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Credits</strong></td>
<td><strong>Credits</strong></td>
<td><strong>Credits</strong></td>
</tr>
</tbody>
</table>

**Freshman Year**

<table>
<thead>
<tr>
<th>Principles of Biology</th>
<th>Environmental Biology</th>
<th>Language in Composition and Reading</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biol. 101</td>
<td>Biol. 103</td>
<td>Engl. 105</td>
</tr>
<tr>
<td>Language in Composition and Reading</td>
<td>History of Landscape Architecture I</td>
<td>Locale Perception</td>
</tr>
<tr>
<td>Engl. 104</td>
<td>L.A. 201</td>
<td>L.A. 113</td>
</tr>
<tr>
<td>Orientation in Landscape Architecture</td>
<td>Mathematics Elective</td>
<td>Social Science Elective</td>
</tr>
<tr>
<td>L.A. 110</td>
<td>Physical Education</td>
<td></td>
</tr>
<tr>
<td>Graphic Communication</td>
<td>L.A. 112</td>
<td></td>
</tr>
<tr>
<td>Library Instruction</td>
<td>L.A. 160</td>
<td></td>
</tr>
<tr>
<td>Physical Education</td>
<td>3</td>
<td></td>
</tr>
</tbody>
</table>

**Sophomore Year**

<table>
<thead>
<tr>
<th>Elementary Surveying</th>
<th>Photogrammetry, Route and Land Surveying</th>
<th>Forestry/Horticulture/Soils Elective</th>
</tr>
</thead>
<tbody>
<tr>
<td>C.E. 211A</td>
<td>C.E. 214</td>
<td>3</td>
</tr>
<tr>
<td>English/Speech Elective</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Plant Materials I</td>
<td>English/Speech Elective</td>
<td>3</td>
</tr>
<tr>
<td>L.A. 231</td>
<td>Fundamentals of Planting Design</td>
<td></td>
</tr>
<tr>
<td>Physical Science Elective</td>
<td></td>
<td>4</td>
</tr>
<tr>
<td>Social Science Elective</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>L.A. 251</td>
<td></td>
</tr>
<tr>
<td>Elective</td>
<td>4</td>
<td></td>
</tr>
</tbody>
</table>

**Junior Year**

<table>
<thead>
<tr>
<th>Forestry/Horticulture/Soils Elective</th>
<th>Outdoor Recreation in the United States</th>
<th>Biological Science Elective</th>
</tr>
</thead>
<tbody>
<tr>
<td>Travel and Practice</td>
<td>L.A. 404</td>
<td>Civil Engineering Elective</td>
</tr>
<tr>
<td>R</td>
<td>L.A. 341</td>
<td>Humanities Elective</td>
</tr>
<tr>
<td>Humanities Elective</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>Landscape Architecture Group</td>
<td>Urban Planning Elective</td>
<td>3</td>
</tr>
<tr>
<td>Elective</td>
<td>Physical Science Elective</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>Elective</td>
<td>4</td>
</tr>
<tr>
<td>Elective</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>
Curriculum in Outdoor Recreation Resources

Administered by the Department of Forestry.
Leading to the degree Bachelor of Science. Total credits required—192, including 3 credits of physical education.
This curriculum provides an educational opportunity for students interested in the management of natural resources for outdoor recreation. Sufficient flexibility is provided to develop a strong minor in a related field.

FALL QUARTER Credits  WINTER QUARTER Credits  SPRING QUARTER Credits

**Freshman Year**

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Precalculus Mathematics</td>
<td>5</td>
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<tr>
<td>Math. 109</td>
<td></td>
</tr>
<tr>
<td>Principles of Biology</td>
<td>3</td>
</tr>
<tr>
<td>Biol. 101</td>
<td></td>
</tr>
<tr>
<td>Experimental Biology</td>
<td>2</td>
</tr>
<tr>
<td>Biol. 101A</td>
<td></td>
</tr>
<tr>
<td>General Chemistry¹</td>
<td>4</td>
</tr>
<tr>
<td>Chem. 141, 141L</td>
<td></td>
</tr>
<tr>
<td>Library Instruction</td>
<td>1</td>
</tr>
<tr>
<td>Lib. 160</td>
<td></td>
</tr>
<tr>
<td>Orientation</td>
<td>R</td>
</tr>
<tr>
<td>0.Rec. 110</td>
<td></td>
</tr>
<tr>
<td>Physical Education</td>
<td>1</td>
</tr>
</tbody>
</table>

**Introduction to Outdoor Recreation Resource Management**

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bot. 107</td>
<td>4</td>
</tr>
<tr>
<td>Language in Composition and Reading</td>
<td>4</td>
</tr>
<tr>
<td>Engl. 104</td>
<td></td>
</tr>
<tr>
<td>General Chemistry</td>
<td>4</td>
</tr>
<tr>
<td>Chem. 142, 142L</td>
<td></td>
</tr>
<tr>
<td>Intuitive Calculus</td>
<td>3</td>
</tr>
<tr>
<td>Math. 161</td>
<td></td>
</tr>
<tr>
<td>Physical Education</td>
<td>1</td>
</tr>
</tbody>
</table>

**General Botany**

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bot. 107</td>
<td>5</td>
</tr>
<tr>
<td>Language in Composition and Reading</td>
<td>4</td>
</tr>
<tr>
<td>Engl. 105</td>
<td></td>
</tr>
<tr>
<td>Intuitive Calculus</td>
<td>3</td>
</tr>
<tr>
<td>Math. 162</td>
<td></td>
</tr>
<tr>
<td>Rural Institutions and Organizations</td>
<td>4</td>
</tr>
<tr>
<td>Soc. 130</td>
<td></td>
</tr>
<tr>
<td>Physical Education</td>
<td>1</td>
</tr>
</tbody>
</table>

**¹Students who have not had high school chemistry should take Chem. 140, 140L.**
<table>
<thead>
<tr>
<th>FALL QUARTER</th>
<th>Credits</th>
<th>WINTER QUARTER</th>
<th>Credits</th>
<th>SPRING QUARTER</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sophomore Year</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>General Zoology Zool. 106</td>
<td>5</td>
<td>Principles of Economics Econ. 241</td>
<td>3</td>
<td>Computer Programming Com.S. 201</td>
<td>3</td>
</tr>
<tr>
<td>Publicity and Public Relations Jl. 225</td>
<td>3</td>
<td>Electives</td>
<td></td>
<td>Physiography of the United States Geol. 230</td>
<td>3</td>
</tr>
<tr>
<td>Electives</td>
<td></td>
<td></td>
<td></td>
<td>Electives</td>
<td>3</td>
</tr>
<tr>
<td><strong>Junior Year</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Natural Resource Economics Econ. 434</td>
<td>3</td>
<td>Government and Conservation Policies</td>
<td>3</td>
<td>Developing and Implementing Public Information Programs Jl. 226</td>
<td>3</td>
</tr>
<tr>
<td>Electives</td>
<td></td>
<td></td>
<td></td>
<td>Management of Outdoor Recreation Resources Economics and Marketing O.Rec. 451</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Electives</td>
<td>4</td>
</tr>
<tr>
<td><strong>Senior Year</strong></td>
<td></td>
<td></td>
<td></td>
<td>Planning Recreation Systems L.A. 445</td>
<td>3</td>
</tr>
<tr>
<td>Management of Outdoor Recreation Resources Quantitative Analysis O.Rec. 452</td>
<td>4</td>
<td>Sociology of Leisure and Recreation Soc. 483</td>
<td>3</td>
<td>Management of Outdoor Recreation Resources Integrative Case Studies O.Rec. 454</td>
<td>3</td>
</tr>
<tr>
<td>Electives</td>
<td>8</td>
<td>Management of Outdoor Recreation Resources Policy and Administration O.Rec. 453</td>
<td>3</td>
<td>Electives</td>
<td>7</td>
</tr>
<tr>
<td>Electives</td>
<td></td>
<td>Electives</td>
<td></td>
<td>Electives</td>
<td></td>
</tr>
</tbody>
</table>

Electives must include 6 credits of humanities and a minor area of concentration of 20 credits. Ag. 104, (six months of practical experience) is also required. A field trip (For. 490 I) is available for majors in the curriculum and may be used to fulfill 3 months of the practical experience requirement.

**Minors:** The minor selected by the student should be appropriate to the curriculum and his long-range professional objectives and interests. Each student will develop the details and objectives of his minor with his adviser. Minors are designed to develop an area of concentration and specialization to supplement the broadly based interdisciplinary requirements of the curriculum and the student's general education, or to develop substantial preparation for graduate study.

**Outdoor Recreation Resources Minors - 20 hours**

<table>
<thead>
<tr>
<th>Biological sciences</th>
<th>Forest management</th>
<th>Urban recreation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Communications</td>
<td>Landscape architecture</td>
<td>Wildlife biology</td>
</tr>
<tr>
<td>Environmental interpretation</td>
<td>Urban forestry</td>
<td></td>
</tr>
</tbody>
</table>
Curriculum in Plant Pathology

Administered by the Department of Botany and Plant Pathology.

Leading to the degree Bachelor of Science. Total credits required—192, including 3 credits of physical education.

The science of plant pathology has significance in agriculture because all cultivated plants are attacked by diseases. These diseases are controlled by procedures developed through experimentation in laboratories, greenhouses, and field plots. A plant pathologist requires rigorous training in basic sciences early in his career so he can participate in research by which new disease control procedures are developed.

In addition to providing the basic training in agriculture and science required as undergraduate preparation for advanced study and professional degrees, a plant pathology major prepares students for positions in business, industry, government service, and teaching. For certification requirements for teachers, see College of Education.

<table>
<thead>
<tr>
<th>College and Departmental Group Requirements</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>I. Written and Spoken English</td>
<td>15</td>
</tr>
<tr>
<td>(including Engl. 104, 105; Sp. 211, Lib. 160)</td>
<td></td>
</tr>
<tr>
<td>II. Mathematics, Statistics</td>
<td>12</td>
</tr>
<tr>
<td>(including Stat. 101)</td>
<td></td>
</tr>
<tr>
<td>III. Physical Sciences</td>
<td>16</td>
</tr>
<tr>
<td>(including Chem. 141, 141L, 142, 142L or 147, 147L, 148, 148L; Phys. 111 or 221)</td>
<td></td>
</tr>
<tr>
<td>IV. Biological Sciences</td>
<td>18</td>
</tr>
<tr>
<td>(including Biol. 101, 101A, 103, Bot. 107, Zool. 106)</td>
<td></td>
</tr>
<tr>
<td>V. Agricultural Sciences</td>
<td>10</td>
</tr>
<tr>
<td>(including Agron. 154A, 206)</td>
<td></td>
</tr>
<tr>
<td>VI. Social Sciences</td>
<td>15</td>
</tr>
<tr>
<td>(including Econ. 241, 242; Pol. S. 215)</td>
<td></td>
</tr>
<tr>
<td>VII. Humanities</td>
<td>15</td>
</tr>
<tr>
<td>(including credits in history and literature)</td>
<td></td>
</tr>
</tbody>
</table>

Departmental Major and Minor Requirements

I. Plant Pathology major, minimum 30 credits.
   (including Bact. 300; Bot. 306, 320, 404, 407, or 416; Gen. 301 or 350; Zool. 370 or 376).

II. One minor of at least 20 credits, or two minors of 15 credits minimum each are required to complete the student's specialized education. Minor areas may include chemistry, mathematics-statistics, zoology-entomology, agronomy, horticulture, forestry, bacteriology, genetics, technical journalism, education, foreign service, and outdoor recreation. Students preparing for graduate studies would commonly include one year of foreign language, and minor areas of chemistry and mathematics-statistics in their program.

Typical Program for the First Two Years

<table>
<thead>
<tr>
<th>FALL QUARTER</th>
<th>WINTER QUARTER</th>
<th>SPRING QUARTER</th>
</tr>
</thead>
<tbody>
<tr>
<td>Credits</td>
<td>Credits</td>
<td>Credits</td>
</tr>
<tr>
<td>Language in Composition and Reading</td>
<td>General Chemistry</td>
<td>Language in Composition and Reading</td>
</tr>
<tr>
<td>Engl. 104</td>
<td>Chem. 141, 141L or 147, 147L</td>
<td>Engl. 105</td>
</tr>
<tr>
<td>Mathematics Requirement</td>
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<tr>
<td>Principles of Biology</td>
<td>Environmental Biology</td>
<td>General Chemistry</td>
</tr>
<tr>
<td>Biol. 101</td>
<td>Biol. 103</td>
<td>Chem. 142, 142L or 148, 148L</td>
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<tr>
<td>Experimental Biology</td>
<td>General Botany</td>
<td>Principles of Statistics</td>
</tr>
<tr>
<td>Biol. 101A</td>
<td>Bot. 107</td>
<td>Stat. 101 (5 cr.)</td>
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<tr>
<td>Library Instruction</td>
<td>Physical Education</td>
<td>Minor Requirements (5 cr.)</td>
</tr>
<tr>
<td>Lib. 160</td>
<td></td>
<td>or</td>
</tr>
<tr>
<td>Physical Education</td>
<td></td>
<td>Fundamentals of Soil Science</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Agron. 154A</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Technical Lecture</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Bot. 110</td>
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<td>Physical Education</td>
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### Fall Quarter Credits

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>Agriculture Science Requirement</td>
<td>3</td>
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<tr>
<td>Principles of Economics</td>
<td></td>
</tr>
<tr>
<td>Econ. 241 (3 cr.)</td>
<td></td>
</tr>
<tr>
<td>Social Science Requirement (3 cr.)</td>
<td>3</td>
</tr>
<tr>
<td>General Zoology</td>
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<td>Zool. 106</td>
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<td>Physical Science Requirement</td>
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<td>Electives</td>
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### Winter Quarter Credits

<table>
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<tbody>
<tr>
<td>Introduction to Meteorology</td>
<td>3</td>
</tr>
<tr>
<td>Agron. 206</td>
<td></td>
</tr>
<tr>
<td>Principles of Economics</td>
<td></td>
</tr>
<tr>
<td>Econ. 242 (3 cr.)</td>
<td></td>
</tr>
<tr>
<td>Social Science Requirement (3 cr.)</td>
<td>3</td>
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<tr>
<td>Physical Science Requirement</td>
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<tr>
<td>Minor Requirements</td>
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<td>Humanities Requirement</td>
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<tr>
<td>Electives</td>
<td>3-5</td>
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</table>

Students electing ROTC may apply these credits toward elective requirements.
Ag. 104 (six months of practical work experience) is required before graduation.

### Spring Quarter Credits

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plant Taxonomy</td>
<td>4</td>
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<tr>
<td>Bot. 306</td>
<td></td>
</tr>
<tr>
<td>Fundamentals of Speech</td>
<td>3</td>
</tr>
<tr>
<td>Sp. 211</td>
<td></td>
</tr>
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<td>Social Science Requirement</td>
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</tr>
<tr>
<td>Humanities Requirement</td>
<td>3</td>
</tr>
<tr>
<td>Electives</td>
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</tr>
<tr>
<td>Minor Requirements</td>
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### Curriculum in Public Service and Administration in Agriculture

Administered by Department of Sociology and Anthropology. Leading to the degree Bachelor of Science. Total credits required—192, including 3 credits of physical education.

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Credits</th>
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<tbody>
<tr>
<td>Principles of Biology</td>
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</tr>
<tr>
<td>Biol. 101</td>
<td>3</td>
</tr>
<tr>
<td>Language in Composition and Reading</td>
<td>4</td>
</tr>
<tr>
<td>Eng. 104</td>
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<td>General Chemistry</td>
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<tr>
<td>Chem. 141, 141L</td>
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<tr>
<td>Finite Mathematics</td>
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<td>Math. 104</td>
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<tr>
<td>Physical Education</td>
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<tr>
<td>Lib. 160</td>
<td>1</td>
</tr>
<tr>
<td>Orientation to Public Service and Administration in Agriculture</td>
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</tr>
<tr>
<td>Soc. 110</td>
<td></td>
</tr>
<tr>
<td>Societal Change and Development</td>
<td>3</td>
</tr>
<tr>
<td>Soc. 391</td>
<td></td>
</tr>
<tr>
<td>American Government</td>
<td></td>
</tr>
<tr>
<td>Pol.S. 215</td>
<td>3</td>
</tr>
<tr>
<td>Principles of Economics</td>
<td></td>
</tr>
<tr>
<td>Econ. 241</td>
<td>3</td>
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<td>Principles of Statistics</td>
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### Fall Quarter Credits

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<tbody>
<tr>
<td>Rural Institutions and Organizations</td>
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<tr>
<td>Soc. 130</td>
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<tr>
<td>Language in Composition and Reading</td>
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<tr>
<td>Eng. 105</td>
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<tr>
<td>Biology of Organisms</td>
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<tr>
<td>Biol. 102B</td>
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<tr>
<td>Environmental Biology</td>
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<td>Biol. 103</td>
<td>3</td>
</tr>
<tr>
<td>General Chemistry</td>
<td></td>
</tr>
<tr>
<td>Chem. 142, 142L</td>
<td>4</td>
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<tr>
<td>Biology of Organisms</td>
<td></td>
</tr>
<tr>
<td>Biol. 102A</td>
<td>2</td>
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<tr>
<td>Physical Education</td>
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</tr>
<tr>
<td>Soc. 110</td>
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</tr>
<tr>
<td>Sociological Inquiry</td>
<td>3</td>
</tr>
<tr>
<td>Soc. 202</td>
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</tr>
<tr>
<td>Fundamentals of Speech</td>
<td>3</td>
</tr>
<tr>
<td>Sp. 211</td>
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<tr>
<td>Animal Production</td>
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<td>An.S. 114</td>
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<td>Agron. 114A</td>
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### Sophomore Year

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>Adoption and Diffusions of Innovations</td>
<td>3</td>
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<tr>
<td>Soc. 392</td>
<td></td>
</tr>
<tr>
<td>Fundamentals of Speech</td>
<td>3</td>
</tr>
<tr>
<td>Sp. 211</td>
<td></td>
</tr>
<tr>
<td>Principles of Economics</td>
<td></td>
</tr>
<tr>
<td>Econ. 242</td>
<td>3</td>
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<tr>
<td>Elementary Organic Chemistry</td>
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<td>Chem. 231, 232</td>
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<tr>
<td>Publicity and Public Relations</td>
<td>3</td>
</tr>
<tr>
<td>JI 225</td>
<td></td>
</tr>
<tr>
<td>Policies of American Government</td>
<td>3</td>
</tr>
<tr>
<td>Pol.S. 216</td>
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</tr>
<tr>
<td>Fundamentals of Soil Science</td>
<td>4</td>
</tr>
<tr>
<td>Agron. 154A</td>
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<tr>
<td>Physical Science Elective</td>
<td>3</td>
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<td>Humanities Elective</td>
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### FALL QUARTER

<table>
<thead>
<tr>
<th>Course</th>
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<tbody>
<tr>
<td>Group Dynamics</td>
<td>3</td>
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<tr>
<td>Soc. 364</td>
<td></td>
</tr>
<tr>
<td>Public Finance</td>
<td>3</td>
</tr>
<tr>
<td>Econ. 405</td>
<td></td>
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<tr>
<td>Introduction to Political Behavior</td>
<td>3</td>
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<tr>
<td>Pol S. 330 (3 cr.)</td>
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<tr>
<td>Public Opinion and Public Policies</td>
<td>3</td>
</tr>
<tr>
<td>Pol S. 467 (winter) (3 cr.)</td>
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### WINTER QUARTER

<table>
<thead>
<tr>
<th>Course</th>
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<tbody>
<tr>
<td>Leadership and Social Interaction</td>
<td>3</td>
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<tr>
<td>Soc. 486</td>
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</tr>
<tr>
<td>Prices and Resource Allocation</td>
<td>3</td>
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<tr>
<td>Econ. 307</td>
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### SPRING QUARTER

<table>
<thead>
<tr>
<th>Course</th>
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<tbody>
<tr>
<td>Analysis of Complex Organizations</td>
<td>3</td>
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<tr>
<td>Soc. 393</td>
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<tr>
<td>Natural Resource Economics</td>
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<tr>
<td>Econ. 434</td>
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<tr>
<td>State and Local Government</td>
<td>3</td>
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<tr>
<td>Pol S. 310 (3 cr.)</td>
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<tr>
<td>Municipal Government and Politics</td>
<td>3</td>
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<td>Pol S. 311 (3 cr.)</td>
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### JUNIOR YEAR

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>Government and Regulation</td>
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<tr>
<td>Pol S. 472 (3 cr.)</td>
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<tr>
<td>or Politics of Food and Fiber Policies</td>
<td>3</td>
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<td>Pol S. 473 (3 cr.)</td>
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<tr>
<td>Government and Conservation Policies</td>
<td>3</td>
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<td>Pol S. 474 (3 cr.)</td>
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<tr>
<td>Public Administration</td>
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<td>Pol S. 471</td>
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</table>

Ag 104 (six months of work experience) is required before graduation

- Students electing ROTC may apply these credits toward elective requirements.

### SENIOR YEAR

<table>
<thead>
<tr>
<th>Course</th>
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<tbody>
<tr>
<td>Community Action</td>
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<tr>
<td>Soc. 464</td>
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<tr>
<td>Agricultural Law</td>
<td>3</td>
</tr>
<tr>
<td>Econ. 451</td>
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<tr>
<td>Administrative Law</td>
<td>3</td>
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<td>Pol S. 476</td>
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Curriculum in Urban Planning

Administered by the Department of Landscape Architecture.
Leading to the degree Bachelor of Science. Total credits required—192, including 3 credits of physical education.

<table>
<thead>
<tr>
<th>FALL QUARTER</th>
<th>WINTER QUARTER</th>
<th>SPRING QUARTER</th>
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</thead>
<tbody>
<tr>
<td>Credits</td>
<td>Credits</td>
<td>Credits</td>
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**Freshman Year**

<table>
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<tr>
<th>Course</th>
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<tbody>
<tr>
<td>Biological Science Elective</td>
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<tr>
<td>Physical Science Elective</td>
<td>4</td>
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<tr>
<td>Orientation in Urban Planning</td>
<td>R</td>
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<tr>
<td>Introduction to Sociology</td>
<td>3</td>
</tr>
<tr>
<td>Library Instruction</td>
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<td>Physical Education</td>
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**Sophomore Year**

<table>
<thead>
<tr>
<th>Course</th>
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<tbody>
<tr>
<td>American Government</td>
<td>3</td>
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<tr>
<td>Architecture Elective</td>
<td>3</td>
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<tr>
<td>Principles of Economics</td>
<td>3</td>
</tr>
<tr>
<td>Fundamentals of Speech</td>
<td>3</td>
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<tr>
<td>Humanities Elective</td>
<td>3</td>
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<tr>
<td>Planning Related Elective</td>
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**Junior Year**

<table>
<thead>
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<th>Course</th>
<th>Credits</th>
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<tr>
<td>State and Regional Planning</td>
<td>3</td>
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<tr>
<td>Collaborative Transportation Development</td>
<td>3</td>
</tr>
<tr>
<td>Master Land Planning</td>
<td>5</td>
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<tr>
<td>Travel and Practice</td>
<td>R</td>
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<tr>
<td>Computer Science Elective</td>
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<td>Minor</td>
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**Senior Year**

<table>
<thead>
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<th>Course</th>
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<tr>
<td>Regional Planning</td>
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<tr>
<td>Planning Law, Administration, and Implementation</td>
<td>5</td>
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<tr>
<td>Urban-Regional Economics</td>
<td>3</td>
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<td>Group Elective</td>
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**Electives**

<table>
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<tr>
<td>Foundations and Frontiers of Physics</td>
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<tr>
<td>Survey of Urban Planning</td>
<td>3</td>
</tr>
<tr>
<td>Language in Composition and Reading</td>
<td>4</td>
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<tr>
<td>Language in Composition and Reading</td>
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<tr>
<td>Humanities Elective</td>
<td>3</td>
</tr>
<tr>
<td>Planning Related Elective</td>
<td>3</td>
</tr>
<tr>
<td>Group Elective</td>
<td>3</td>
</tr>
<tr>
<td>Theory of Planning Process</td>
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<tr>
<td>Planning Analysis and Techniques</td>
<td>4</td>
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<tr>
<td>Housing and Urban Renewal</td>
<td>3</td>
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<tr>
<td>Traffic Planning</td>
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<td>Urban-Regional Economics</td>
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<tr>
<td>Urban Development Planning</td>
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<tr>
<td>Group Electives</td>
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<tr>
<td>Minor</td>
<td>6</td>
</tr>
</tbody>
</table>

For the humanities electives, the student should choose a sequence from one of the following three fields: philosophy, history, literature.

The following courses are suggested for completion of the biological science elective: Biol 101, 102A, 102B, 103.
Group Electives. A minimum of one course must be elected from Groups I and II, and a minimum of two courses must be elected from Groups III and IV.

I. Housing: Arch. 363; F. E. 340, 521.
III. Area Government, Administration, and Finances: Pol. S. 310, 311, 471, 476; Econ. 405.
IV. Sociology and Geography of Urban Areas: Soc. 135, 300, 305, 310, 331, 364, 410, 450; Geog. 421.

Planning Related Electives:
I. Urban Design Path—Stressing Design courses in architecture, landscape architecture, and civil engineering.
II. Socio-Economic-Administrative Path—Stressing courses in sociology, economics, political science, computer science, family environment, journalism and mass communications, and other related fields.

Ag. 104 (six months of work experience) is required before graduation.
Training in Agriculture with Special Objectives

Training for Extension Service

Students interested in preparing for work in the Extension Service may be referred to an extension adviser who is a member of the Extension Service staff. By cooperation between the extension adviser and the student’s departmental adviser, the following courses may be recommended for substitution in place of required courses or used as electives in the student’s curriculum. The program indicates the quarter in which it would be desirable to take the recommended courses, although the courses might be taken in other quarters. This program should be planned not later than the sophomore year. Such students will remain in one of the regular subject matter curricula. Other courses may be suggested in addition to or in lieu of the following courses depending upon the specific area of interest with the Extension Service.

<table>
<thead>
<tr>
<th>FALL QUARTER</th>
<th>WINTER QUARTER</th>
<th>SPRING QUARTER</th>
</tr>
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<tbody>
<tr>
<td>Credits</td>
<td>Credits</td>
<td>Credits</td>
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<tr>
<td><strong>Sophomore Year</strong></td>
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<tr>
<td>General Psychology</td>
<td>Introduction to Sociology*</td>
<td>Educational Psychology</td>
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<tr>
<td>Psych. 101</td>
<td>Soc. 134</td>
<td>Psych. 333</td>
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<tr>
<td>Observation and Survey of Program of Education in Agriculture</td>
<td>Developmental Psychology</td>
<td>Methods of Teaching</td>
</tr>
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<td>Ag Ed. 211B</td>
<td>Psych. 230</td>
<td>Educ. 305</td>
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<tr>
<td><strong>Junior Year</strong></td>
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<td></td>
</tr>
<tr>
<td>Sociological Inquiry</td>
<td>Group Dynamics</td>
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<tr>
<td>Soc. 202</td>
<td>Soc. 364</td>
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<td></td>
<td>Publicity and Public Relations</td>
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<td>Jl 225</td>
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<td><strong>Senior Year</strong></td>
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<tr>
<td>Extension Education</td>
<td>Community Action</td>
<td>Business Communication</td>
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<td>Educ. 468</td>
<td>Soc. 464</td>
<td>Engl. 404</td>
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<td>Leadership and Social Interaction</td>
<td>Business and Professional</td>
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<tr>
<td></td>
<td>Soc. 486</td>
<td>Speaking</td>
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<td></td>
<td>Sp 312</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3</td>
</tr>
</tbody>
</table>

* Soc. 130, if required in the student’s curriculum, will meet this need.

Preparation for Graduate Study

The student who expects to earn an advanced degree in an area of technical agriculture should take some of the more fundamental courses indicated below. In addition to these strongly recommended courses, students will find calculus, physical chemistry, genetics, bacteriology, botany, and zoology to be valuable. The student should consult his adviser in determining the extent to which he might substitute these fundamental courses for the more applied courses required in his curriculum.

A knowledge of statistics and the principles of technical writing is essential in the preparation of a thesis, which is required for the degree Master of Science or Doctor of Philosophy in agriculture. Graduate students usually are required to have a reading knowledge of French, Spanish, Russian, or German.
<table>
<thead>
<tr>
<th>Year</th>
<th>Course</th>
<th>Credits</th>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sophomore Year</td>
<td>Organic Chemistry Chem. 334</td>
<td>3</td>
<td>Organic Chemistry Chem. 335</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Analytic Geometry and Calculus I Math. 110</td>
<td>5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Junior Year</td>
<td>Quantitative Analysis Chem. 211</td>
<td>5</td>
<td>General Physics Phys. 112</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>General Physics Phys. 111</td>
<td>4</td>
<td>Writing of Reports and Technical Papers Engl. 414</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>General Physics Phys. 113</td>
<td>4</td>
</tr>
</tbody>
</table>

Training for International Service

Agricultural students desiring to work in foreign countries with private industry, governmental agencies, or private foundations and institutions are referred to the section headed *International Studies Programs* for suggested courses they might take as electives or as substitutes for required courses.
An effective teacher needs broad personal and professional knowledge and understanding. The College of Education strives to provide each prospective teacher with a sound general education and background as well as preparation in an area of specialization. With these must go an understanding of teaching and of learning and a skill in applying such understanding in the classroom, plus an awareness of the characteristics of growth and development of students and society.

All students who are recommended by Iowa State University for teacher certification must be recommended by the College of Education. However, each student will be enrolled in the department in which he plans to major, and he must meet the graduation requirements of that department and the college in which it is located.

Within the College of Education, courses are offered in education for all undergraduate students seeking teaching certificates for the elementary and secondary schools. In addition, certain undergraduate nonteaching programs and several professional programs at the graduate level are offered.

ADMISSION TO UNDERGRADUATE PROGRAM

A student seeking admission to a teacher education program must be accepted by a selection committee for the specific program which he seeks to enter. Factors considered in evaluating applications include scholarship, interest in teaching, character, and physical and mental health. Recommendations by selection committees must be confirmed by the Committee on Academic Standards of the College of Education before admittance to the program in teacher education is granted.

Students should apply at least four quarters before the one in which they plan to enroll in student teaching.

A 2.3 quality point average is required for admittance to the teacher education program, and this minimum average must be maintained through graduation.

TEACHER CERTIFICATION

The Iowa Professional Certificate may be recommended for those who hold the bachelor's degree from Iowa State and who have completed the following:

1. All requirements of an approved teacher education program.
2. A minimum of 75 credits in courses designed to serve the general needs of college students.

For full-time teaching in secondary schools an approved subject matter concentration of at least 45 credits is required. A second subject matter area of at least 30 credits for halftime teaching is possible but not required.

Approval for the elementary certificate requires the successful completion of the curriculum in elementary education.

Approval for the nursery school-kindergarten certificate requires the successful completion of that curriculum in the Department of Child Development.

Graduate programs are available for those who seek approval as elementary and secondary school principals, superintendents, school psychologists, counselors, or teachers in junior and community colleges.

Information concerning certificates not described above, as well as more detailed requirements for any certificate, may be obtained from the Dean of the College of Education.
THE GENERAL EDUCATION REQUIREMENT

All prospective teachers are required to complete a program in general education which is integrated with their professional training and extends through the undergraduate curriculum.

The general education program emphasizes intellectual growth and personal development as contrasted with specific vocational preparation. It is recognized that many contributions to general education may be made by courses which have other primary objectives.

The program aims to stimulate a desire for learning and intellectual endeavor, develop understanding and appreciation for the physical and cultural world, encourage independent thinking and analysis, increase competence in all aspects of communication, and create an understanding of man as a social, psychological, and physical being.

The student is expected to complete studies in five groupings in general education. Areas represented below are not departmental titles. In some cases, courses relating to a given area may be found in several different departments.

I. Physical sciences and mathematics........................................ 9-21 credits
II. Biological sciences................................................................. 9-21 credits
III. Social sciences........................................................................ 9-21 credits
IV. Humanities............................................................................... 9-21 credits
V. Communicative arts................................................................. 14-21 credits

A minimum total of 75 credits must be earned in general education, with the minimum and maximum in each group as shown above. This total will include Engl. 104 and 105, Sp. 211, Pol. S. 215, and Psych. 101.

A course may not be counted in general education and also in the academic major or minor.

Additional credits in general education may be required by departments preparing teachers.

All students must earn a minimum of 3 credits in physical education.
THE PROFESSIONAL EDUCATION REQUIREMENT

As part of a total educational program, the prospective teacher must complete certain studies related directly to the profession of teaching.

All students in teacher education take the following courses:

- Foundations of American Education, Educ. 204 3 credits
- Methods of Teaching, Educ. 305B 1 credit
- Developmental Psychology, Psych. 230 3 credits
- Educational Psychology, Psych. 333 3 credits

The additional courses required by specific teaching areas are:

ELEMENTARY EDUCATION
See Curriculum in Elementary Education.

NURSERY-KINDERGARTEN EDUCATION
See Index, Child Development for complete requirements

SECONDARY EDUCATION

- Methods of Teaching, Educ. 305A 3 credits
- Principles of Secondary Education, Educ. 426 3 credits

Professional Courses in Areas of Specialization

- Agricultural Education: Ag.Ed. 211, 321, 412, 414, 417
- Art A.A. 415, 416, 417, 418, 419
- Biology D. St. 417D, 486
- Chemistry D. St. 417B, 486
- Earth Science D. St. 417J, 486
- English Eng. 494, D. St. 417E
- Foreign Languages: F. L. 417G, D. St. 417G
- General Science D. St. 417B, 486
- Home Economics Education H Ed. 406, 407, 410, 417
- Industrial Education: I.Ed. 415, 417
- Journalism Jl. 480, D. St. 417I
- Mathematics: Math. 497, D. St. 417C.
- Music: Music 366, 466, (367-368-3691), D. St. 417K, 417L.
- Physical Education for Men P. E. M. 497, D. St. 417F.
- Physical Education for Women P. E. W. 259, 275, 376, 385, 417, or 417 and 418.
- Physics: D. St. 417B, 486.
- Safety Education I.Ed. 216, 316, 317, 418, 419, 571
- Social Studies D. St. 417A, 496.
- Speech Sp. 495, D. St. 417H.

1Practicum series and minor applied music not required for those planning to teach vocal choral music.

THE REQUIREMENTS FOR AREAS OF SPECIALIZATION

A teacher must also be competent in the area of a teaching specialization. Certain competencies are required of those who would teach at nursery-kindergarten or the elementary level, for instance, while a depth of knowledge in some particular subject matter is necessary for those who would be teachers at the secondary level.

The specific course requirements for each area of specialization follow.

ELEMENTARY EDUCATION

Students seeking approval for teaching in elementary education must earn credits in the following courses.

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Child Development</td>
<td>236</td>
</tr>
<tr>
<td></td>
<td>337</td>
</tr>
<tr>
<td></td>
<td>460</td>
</tr>
<tr>
<td>Elementary Education</td>
<td>344</td>
</tr>
<tr>
<td></td>
<td>375</td>
</tr>
<tr>
<td></td>
<td>445</td>
</tr>
<tr>
<td></td>
<td>467C</td>
</tr>
<tr>
<td></td>
<td>467D</td>
</tr>
<tr>
<td>Related Courses (Elect 3 credits)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>C D. 240, 336, or 366</td>
</tr>
<tr>
<td></td>
<td>F E. 270</td>
</tr>
<tr>
<td></td>
<td>Sp. 362</td>
</tr>
</tbody>
</table>
184 Colleges and Curricula

Related Methods (Elect 9 credits)
A.A. 200
Eli.Ed. 447, 455, 456
Mus. 365
P E W 470
Sp. 375

NURSERY-KINDERGARTEN

Students seeking approval to teach at the nursery-kindergarten level must complete the child development core and earn the following credits.

Child Development. 461 3 credits of electives from English, journalism, or speech.
467A 3 credits from sociology.
467B 3 credits from mathematics.
467E
468

VOCATIONAL AGRICULTURE

Students seeking approval to teach vocational agriculture must earn credits in the following courses.

Agricultural Engineering: 254 114A 114
255 154A
334 315
415 354
Economics. 230
241 18 credits of electives in technical agriculture.
242 3 credits Agricultural Engineering Elective.
330 3 credits Economics Elective.

APPLIED ART

Students seeking approval to teach art in secondary schools must earn credits in the following courses:

Applied Art: 100 244 303 350
104 247 310 370
150 250 340 384
170 261 345 446
203 270 347 484
233 300

Students seeking approval to teach art (kindergarten through grade 12) must earn credits in the following courses:

Applied Art: 100 233 345 303
104 244 or 247 347 310
150 250 or 350 370 333
170 261 384
203 300
340

Students seeking restricted approval to teach art must earn credits in the following courses:

Applied Art: 103 Two courses selected from.
150 104, 170, 244, 247, 278, 303, 333, 348, 350
233
261
345
347
384
### Biology
Students seeking approval to teach biology must earn credits in the following courses.

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
<th>Course</th>
<th>Credits</th>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bacteriology</td>
<td>300</td>
<td>Botany</td>
<td>107</td>
<td>Genetics</td>
<td>301 or 350 or 400</td>
</tr>
<tr>
<td>Biochemistry and Biophysics</td>
<td>301 or 401 or 405</td>
<td>203 or 306 or 301</td>
<td>203 or 306 or 404</td>
<td>Zoology</td>
<td>106</td>
</tr>
<tr>
<td>Biophysics</td>
<td>301 or 401 or 405</td>
<td>301 or 350 or 400</td>
<td>4 or more credits</td>
<td>155 or 455</td>
<td></td>
</tr>
<tr>
<td>Zoology</td>
<td>106</td>
<td>Genetics</td>
<td>301 or 350 or 400</td>
<td>155 or 455</td>
<td></td>
</tr>
<tr>
<td>Biology</td>
<td>101</td>
<td>Botany</td>
<td>107</td>
<td>Zoology</td>
<td>106</td>
</tr>
<tr>
<td>Biology</td>
<td>101A</td>
<td>Botany</td>
<td>107</td>
<td>Zoology</td>
<td>106</td>
</tr>
<tr>
<td>Biology</td>
<td>103</td>
<td>Botany</td>
<td>107</td>
<td>Zoology</td>
<td>106</td>
</tr>
</tbody>
</table>

Students seeking restricted approval to teach biology must earn credits in the following courses.

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
<th>Course</th>
<th>Credits</th>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bacteriology</td>
<td>300</td>
<td>Botany</td>
<td>107</td>
<td>Zoology</td>
<td>106</td>
</tr>
<tr>
<td>Genetics</td>
<td>301 or 350 or 400</td>
<td>203 or 306 or 404</td>
<td>203 or 306 or 404</td>
<td>Zoology</td>
<td>106</td>
</tr>
<tr>
<td>Biochemistry and Biophysics</td>
<td>301 or 401 or 405</td>
<td>301 or 350 or 400</td>
<td>4 or more credits</td>
<td>155 or 455</td>
<td></td>
</tr>
<tr>
<td>Botany</td>
<td>301 or 401 or 405</td>
<td>203 or 306 or 404</td>
<td>203 or 306 or 404</td>
<td>Zoology</td>
<td>106</td>
</tr>
<tr>
<td>Biology</td>
<td>101</td>
<td>Botany</td>
<td>107</td>
<td>Zoology</td>
<td>106</td>
</tr>
<tr>
<td>Biology</td>
<td>101A</td>
<td>Botany</td>
<td>107</td>
<td>Zoology</td>
<td>106</td>
</tr>
<tr>
<td>Biology</td>
<td>103</td>
<td>Botany</td>
<td>107</td>
<td>Zoology</td>
<td>106</td>
</tr>
</tbody>
</table>

### Chemistry
Students seeking approval to teach chemistry must earn credits in the following courses.

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
<th>Course</th>
<th>Credits</th>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemistry</td>
<td>141 and 141L and 142 and 142L, or 147 and 147L and 148 and 148L</td>
<td>203 or 306 or 404</td>
<td>203 or 306 or 404</td>
<td>Zoology</td>
<td>106</td>
</tr>
<tr>
<td>Chemistry</td>
<td>141 and 141L and 142 and 142L, or 147 and 147L and 148 and 148L</td>
<td>203 or 306 or 404</td>
<td>203 or 306 or 404</td>
<td>Zoology</td>
<td>106</td>
</tr>
<tr>
<td>Chemistry</td>
<td>141 and 141L and 142 and 142L, or 147 and 147L and 148 and 148L</td>
<td>203 or 306 or 404</td>
<td>203 or 306 or 404</td>
<td>Zoology</td>
<td>106</td>
</tr>
<tr>
<td>Chemistry</td>
<td>141 and 141L and 142 and 142L, or 147 and 147L and 148 and 148L</td>
<td>203 or 306 or 404</td>
<td>203 or 306 or 404</td>
<td>Zoology</td>
<td>106</td>
</tr>
<tr>
<td>Biochemistry and Physics</td>
<td>301</td>
<td>Botany</td>
<td>107</td>
<td>Zoology</td>
<td>106</td>
</tr>
<tr>
<td>Biochemistry and Physics</td>
<td>301</td>
<td>Botany</td>
<td>107</td>
<td>Zoology</td>
<td>106</td>
</tr>
<tr>
<td>Biochemistry and Physics</td>
<td>301</td>
<td>Botany</td>
<td>107</td>
<td>Zoology</td>
<td>106</td>
</tr>
<tr>
<td>Biochemistry and Physics</td>
<td>301</td>
<td>Botany</td>
<td>107</td>
<td>Zoology</td>
<td>106</td>
</tr>
</tbody>
</table>

### Earth Science
Students seeking approval to teach earth science must earn credits in the following courses.

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
<th>Course</th>
<th>Credits</th>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geology</td>
<td>100</td>
<td>Meteorology</td>
<td>206</td>
<td>Physics</td>
<td>151</td>
</tr>
<tr>
<td>Geology</td>
<td>200</td>
<td>Meteorology</td>
<td>406</td>
<td>Physics</td>
<td>152</td>
</tr>
<tr>
<td>Geology</td>
<td>201</td>
<td>Meteorology</td>
<td>406</td>
<td>Physics</td>
<td>153</td>
</tr>
<tr>
<td>Geology</td>
<td>204</td>
<td>Meteorology</td>
<td>406</td>
<td>Physics</td>
<td>153</td>
</tr>
<tr>
<td>Geology</td>
<td>271</td>
<td>Meteorology</td>
<td>406</td>
<td>Physics</td>
<td>153</td>
</tr>
<tr>
<td>Geology</td>
<td>302 (Field course, 9 cr.)</td>
<td>Meteorology</td>
<td>406</td>
<td>Physics</td>
<td>153</td>
</tr>
<tr>
<td>Geography</td>
<td>201</td>
<td>Meteorology</td>
<td>406</td>
<td>Physics</td>
<td>153</td>
</tr>
<tr>
<td>Geography</td>
<td>322</td>
<td>Meteorology</td>
<td>406</td>
<td>Physics</td>
<td>153</td>
</tr>
</tbody>
</table>
Students seeking restricted approval to teach earth science must earn credits in the following courses.

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geography</td>
<td>201</td>
</tr>
<tr>
<td>Geology</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td>204</td>
</tr>
<tr>
<td></td>
<td>271</td>
</tr>
<tr>
<td>Meteorology</td>
<td>206</td>
</tr>
<tr>
<td>Physics</td>
<td>151</td>
</tr>
<tr>
<td></td>
<td>152</td>
</tr>
</tbody>
</table>

3 credits in geology or meteorology courses numbered 300 or above.

**ENGLISH**

Students seeking approval to teach English must earn credits in the following courses.

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>English 304A</td>
<td>375A</td>
</tr>
<tr>
<td>363A</td>
<td>376A</td>
</tr>
<tr>
<td>364A</td>
<td>419</td>
</tr>
<tr>
<td>374A</td>
<td>464A</td>
</tr>
</tbody>
</table>

One course in each of the following:
- Modern literature
- World literature
- Advanced literature or language or literary criticism

Students seeking restricted approval to teach English must earn 30 credits in the following courses.

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>English 304A</td>
<td>374A</td>
</tr>
<tr>
<td>363A</td>
<td>419</td>
</tr>
<tr>
<td>364A</td>
<td>464A</td>
</tr>
</tbody>
</table>

**FOREIGN LANGUAGES**

Students seeking approval to teach foreign languages must earn 45 credits in one language.

French majors must include:

<table>
<thead>
<tr>
<th>Course</th>
</tr>
</thead>
<tbody>
<tr>
<td>204</td>
</tr>
<tr>
<td>311</td>
</tr>
<tr>
<td>312</td>
</tr>
<tr>
<td>313</td>
</tr>
</tbody>
</table>

Spanish majors must include:

<table>
<thead>
<tr>
<th>Course</th>
</tr>
</thead>
<tbody>
<tr>
<td>354</td>
</tr>
<tr>
<td>355</td>
</tr>
<tr>
<td>356</td>
</tr>
<tr>
<td>357</td>
</tr>
<tr>
<td>358</td>
</tr>
<tr>
<td>359</td>
</tr>
</tbody>
</table>

German majors must include:

<table>
<thead>
<tr>
<th>Course</th>
</tr>
</thead>
<tbody>
<tr>
<td>336</td>
</tr>
<tr>
<td>337</td>
</tr>
<tr>
<td>338</td>
</tr>
</tbody>
</table>

Russian majors must include:

<table>
<thead>
<tr>
<th>Course</th>
</tr>
</thead>
<tbody>
<tr>
<td>324</td>
</tr>
<tr>
<td>325</td>
</tr>
<tr>
<td>326</td>
</tr>
<tr>
<td>327</td>
</tr>
<tr>
<td>328</td>
</tr>
<tr>
<td>329</td>
</tr>
</tbody>
</table>

Students seeking restricted approval to teach a foreign language must earn 30 credits in that language. Nine of the 30 credits must be in composition and conversation.

Prior to receiving either full or restricted approval the candidate must demonstrate adequate speaking proficiency in the language to be taught.

**GENERAL SCIENCE**

Students seeking approval to teach general science must complete one of the following five alternate sets of requirements.

1. The student must complete full approval to teach biology and must earn credits in the following courses:

   - Physics: 111 and 112 and 113, or 221 and 222 and 223
   - Geology: 100
   - Chemistry: 141 and 141L and 142 and 142L, or 147 and 147L and 148 and 148L, or 114 and 115

2. The student must complete full approval to teach chemistry and must earn credits in the following courses:

   - Botany: 107
   - Biology: 101, 101A
   - Geology: 100
   - Meteorology: 206, 208
   - Zoology: 106 or 155

3. The student must complete full approval to teach earth science and must earn credits in the following courses:

   - Botany: 107
   - Biology: 101, 101A
   - Chemistry: 141 and 141L and 142 and 142L, or 147 and 147L and 148 and 148L, or 114 and 115
   - Physics: 111 and 112, or 221 and 222 and 223
   - Zoology: 106 or 155
The student must complete full approval to teach physics and must earn credits in the following courses:

- Botany: 107
- Biology: 101, 101A
- Geology: 100
- Meteorology: 206, 208
- Zoology: 106 or 155

The student must earn credits in the following courses:

- Biology: 101, 101A, 103
- Botany: 107
- Zoology: 106 or 155
- Chemistry: 141 and 141L and 142 and 142L, or 147 and 147L and 148 and 148L, or 114 and 115
- Geology: 100
- Physics: 111 and 112 and 113, or 221 and 222 and 223
- Meteorology: 206, 208
- Physics: 151 and 152, or 344 and 345

At least 3 credits in genetics or bacteriology.
At least 6 additional credits from courses numbered 300 or above in bacteriology, biochemistry and biophysics, biology, botany, chemistry, genetics, geology, meteorology, physics, and zoology.

**HOME ECONOMICS**

Students seeking approval to teach home economics must complete credits in the following courses:

<table>
<thead>
<tr>
<th>Applied Art. 103</th>
<th>Family Environment 254 or 318</th>
<th>Food and Nutrition 107</th>
</tr>
</thead>
<tbody>
<tr>
<td>261</td>
<td>285 or 385</td>
<td>208</td>
</tr>
<tr>
<td>236</td>
<td>375 or I. Mgt. 287</td>
<td>303</td>
</tr>
<tr>
<td>337</td>
<td>415 or 488</td>
<td>Textiles and Clothing 104</td>
</tr>
<tr>
<td></td>
<td>489 or I. Mgt. 380</td>
<td>123 or 125</td>
</tr>
<tr>
<td></td>
<td></td>
<td>245</td>
</tr>
</tbody>
</table>

Three credits chosen from AA 262, Arch. 361, F E 240, 308, 412, 445, 446, 521. Twelve credits chosen from home economics and related courses in one of the following areas food and nutrition, housing, human development and family management, textiles and clothing.

**INDUSTRIAL EDUCATION**

Students seeking approval to teach industrial education must earn credits in the following courses:

<table>
<thead>
<tr>
<th>Industrial Education 105</th>
<th>205</th>
<th>251</th>
<th>310</th>
<th>Architecture 334</th>
</tr>
</thead>
<tbody>
<tr>
<td>106</td>
<td>220</td>
<td>253</td>
<td>357</td>
<td>Agricultural Engineering 359</td>
</tr>
<tr>
<td>110</td>
<td>232</td>
<td>260</td>
<td>370</td>
<td>6 credits selected from I Ed.</td>
</tr>
<tr>
<td>121</td>
<td>234</td>
<td>261</td>
<td>410</td>
<td>308, 324, 336.</td>
</tr>
<tr>
<td>122</td>
<td>236</td>
<td>262</td>
<td>514</td>
<td></td>
</tr>
<tr>
<td>123</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**JOURNALISM**

Students seeking approval to teach journalism must earn 32 credits in journalism as follows:

<table>
<thead>
<tr>
<th>Journalism 101</th>
<th>317</th>
<th>Two courses chosen from Journalism 318 337</th>
<th>Two courses chosen from Journalism 415 440</th>
</tr>
</thead>
<tbody>
<tr>
<td>201</td>
<td>341</td>
<td>319 338</td>
<td>417 462</td>
</tr>
<tr>
<td>202</td>
<td>480</td>
<td>325 342</td>
<td>425 463</td>
</tr>
<tr>
<td></td>
<td>490J</td>
<td>326 348</td>
<td>430 464</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>431</td>
</tr>
</tbody>
</table>

Fifteen credits in written and spoken English.

Students seeking restricted approval to teach journalism must earn credits in the following courses:

<table>
<thead>
<tr>
<th>Journalism 101</th>
<th>202</th>
<th>317</th>
<th>431 or 462</th>
</tr>
</thead>
<tbody>
<tr>
<td>201</td>
<td>203</td>
<td>341</td>
<td></td>
</tr>
</tbody>
</table>
MATHEMATICS

Students seeking approval to teach mathematics must earn credits in the following courses:

Mathematics:
- 110 15 credits in courses numbered 200 or above
- 111
- 112
- 201
- 202
- 301
- 330 or 331 or 436
- 490

Students seeking restricted approval to teach mathematics must earn credits in the following courses:

Mathematics:
- 110 202
- 111 301
- 112 330 or 331 or 436
- 201 490

MUSIC

Students seeking approval to teach music (kindergarten through grade 12) must earn credits in the following courses:

Child Development:
- 236
- 337
- 460

Elementary Education:
- 344

Music:
- 104
- 319
- 490B
- 119 361
- 219 362
- 304 366
- 305 419
- 306 466

4 to 6 credits from advanced music history courses.

Music 310 is required for students planning to teach vocal music.

Music 367, 368, 369, 467, 468 and 469 are required for students planning to teach instrumental music.

Students seeking approval to teach in only the secondary school should confer with the Music Department concerning modifications in this program.

PHYSICAL EDUCATION FOR MEN

Students seeking approval to teach physical education for men must earn credits in the following courses:

Hygiene:
- 104
- 304

Zoology:
- 155
- 359

Physical Education for Men:
- 200
- 201
- 205
- 305
- 320
- 330
- 494

Physical Education for Women:
- 370

Twelve credits chosen from:

Physical Education for Men:
- 212 314
- 214 315
- 215 316
- 216 317
- 217 492
- 218 498
- 219

8 credits chosen from:

Physical Education for Men:
- 230
- 231
- 232
- 340
- 405
- 490
- 496

Physical Education for Women:
- 480
**PHYSICAL EDUCATION FOR WOMEN**

Students seeking approval to teach physical education for women must earn credits in the following courses:

<table>
<thead>
<tr>
<th>Physical Education for Women:</th>
<th>Hygiene: 104</th>
<th>304</th>
</tr>
</thead>
<tbody>
<tr>
<td>118</td>
<td>251</td>
<td>399</td>
</tr>
<tr>
<td>165</td>
<td>370</td>
<td>452</td>
</tr>
<tr>
<td>190</td>
<td>480</td>
<td></td>
</tr>
</tbody>
</table>

Additional courses in one of three options:

**A. PHYSICAL EDUCATION FOR WOMEN SECONDARY**

<table>
<thead>
<tr>
<th>Physical Education for Women:</th>
<th>150</th>
<th>252</th>
<th>377</th>
</tr>
</thead>
<tbody>
<tr>
<td>151</td>
<td>270 or 271</td>
<td>420</td>
<td></td>
</tr>
<tr>
<td>152</td>
<td>375</td>
<td>440</td>
<td></td>
</tr>
<tr>
<td>250</td>
<td>223</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1 credit of swimming elective

**B. DANCE**

<table>
<thead>
<tr>
<th>Physical Education for Women:</th>
<th>117</th>
<th>380</th>
</tr>
</thead>
<tbody>
<tr>
<td>220</td>
<td>382</td>
<td></td>
</tr>
<tr>
<td>222</td>
<td>386</td>
<td></td>
</tr>
<tr>
<td>223</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**C. PHYSICAL EDUCATION IN ELEMENTARY SCHOOLS**

All requirements for Option A

Child Development 337

Elementary Education 344

Music 365

Physical Education for Women: 260

261

**PHYSICAL SCIENCE**

Students seeking approval to teach physical science must earn credits in the following courses:

The courses listed for restricted approval, plus completion of Physics 151, 152, 153, or Physics 344, 345.

Three or 4 credits of organic chemistry.

Eight credits from courses numbered 200 and above in physics, chemistry, meteorology, and geology (except Geol. 203).

Students seeking restricted approval to teach physical science must earn credits in the following courses:

**Physics:** 111 or 221, 222, 223

112

113 or 231, 232, 233

or 301, 302

or 421, 422, 423

At least 2 credits from

Physics: 151 or 152 or 153 or 344 or 345

**Chemistry:** 141 or 147 or 114

141L 147L 115

142 148

142L 148L

**Meteorology:** 206

208

**Geology:** 100

**PHYSICS**

Students seeking approval to teach physics must earn credits in the following courses:

<table>
<thead>
<tr>
<th>Physics:</th>
<th>221</th>
<th>301</th>
<th>310</th>
</tr>
</thead>
<tbody>
<tr>
<td>311T</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>222</td>
<td>302</td>
<td>344</td>
<td></td>
</tr>
<tr>
<td>345</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>394</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>399 (3 credits)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

3 credits in physics courses numbered 300 or above

Students seeking restricted approval to teach physics must earn credits in the following courses:

<table>
<thead>
<tr>
<th>Physics:</th>
<th>221</th>
<th>301</th>
<th>344</th>
</tr>
</thead>
<tbody>
<tr>
<td>222</td>
<td>302</td>
<td>345</td>
<td></td>
</tr>
<tr>
<td>223</td>
<td>311T</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
SAFETY EDUCATION AND DRIVER EDUCATION

All students who qualify for approval to teach safety education and driver education must have preparation in some major area of specialization. Such students may then obtain approval to teach safety education and driver education by earning the following credits:

Fifteen credits chosen from

<table>
<thead>
<tr>
<th>Industrial Education:</th>
<th>216</th>
<th>570</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>316</td>
<td>571</td>
</tr>
<tr>
<td></td>
<td>317</td>
<td>590S</td>
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<tr>
<td></td>
<td>418</td>
<td></td>
</tr>
<tr>
<td></td>
<td>419</td>
<td></td>
</tr>
</tbody>
</table>

Fifteen credits chosen from

| C.E. 352, 450 |
| Econ. 305, 444, 445 |
| Educ. 502, 503, 536 and/or 537, 552, 553 |
| F.E. 254 |
| I.Ed. 360, 463, 465 |
| I.E. 421 |
| I.Ed. 262, 310 |

SOCIAL STUDIES

For approval to teach social studies a student must receive approval to teach in three or more of the following areas: world history, American history, sociology, economics, American government, geography. For approval the student must earn 15 credits in each of the chosen fields as follows.

ECONOMICS—15 credits from:

| Economics: 241 | 307 |
| 242 | 314 |
| 243 | 411 |
| 305 | 455 |
| 306 |

GEOGRAPHY—15 credits from

| Geography: 201 |
| 202 |
| 302 |
| 305 |
| 310 |
| Geology: 100 |
| 200 |
| 201 |
| 230 |

SOCIOLOGY—Soc. 134 and 12 credits from

| Sociology 201 |
| 202 |
| 302 |
| 305 |
| 310 |
| Anthropology 111 |
| 220 |
| 313 |
| 321 |
| 322 |
| 323 |
| 324 |
| 325 |

AMERICAN GOVERNMENT—15 credits from

| Political Science: 216 |
| 241 |
| 251 |
| 310 |
| 311 |
| 320 |
| 330 |
| 360 |
| 410 |
| 462B, 462C, 474A, 477A |
| 466, 468A, 474B, 477B |
| 475, 469A, 469B, 469C, 477C, 478 |

UNITED STATES HISTORY—15 credits with at least one course from each group

| History 1. 221, 462B, 462C, 474A, 477A |
| 2. 222, 286, 464, 466, 468A, 474B, 477B |
| 3. 223, 286, 469A, 469B, 469C, 477C, 478 |

WORLD HISTORY—15 credits with at least one course from each group

| History 1. 201, 325, 403A, 403B, 403C, 404A, 404B, 404C, 407 |
| 2. 202, 325, 351, 408, 512A, 517A |

Students seeking restricted approval to teach any two of the above areas must earn 15 credits in each of the areas chosen. Restricted approval will be granted only to those students who have full approval in one or more of the following areas: English, foreign languages, home economics, journalism and speech.
SPEECH

Students seeking approval to teach speech must earn credits in the following courses:

Speech: 215 360
309 375
322 412
332

Eighteen credits from other speech courses numbered 300 or above as well as the credits in Engl. 104, 105 or its equivalent.

Advisers for Areas of Specialization

Persons interested in teaching in one of the following areas should consult with the appropriate individual. Details of each area will be found in the appropriate departmental section.

ELEMENTARY EDUCATION
Jess Beard

SECONDARY EDUCATION
Agricultural Education
Clarence E. Bundy
Art
Marvin Spomer
Biology
Delma E. Harding
Chemistry
Robert E. McCarley
Earth Science
Fred DeLuca
English
Richard Zbaracki
Foreign Languages
Walter Chatfield
General Science
George Knaphus
Home Economics Education
Dorthea Gienger
Industrial Education
William Wolansky

NURSERY-KINDERGARTEN
Samuel Clark

Journalism
James W. Schwartz
Mathematics
William Rudolph
Music
Laurence Burkhalter
Physical Education for Men
Leo Schneider
Physical Education for Women
Barbara E. Forker
Physics
James E. Dixon
Safety Education
Lillian C. Schwenk
Social Studies (economics, sociology, government, geography, and history)
Clair Keller
Speech
Russell Myers

1 Students qualifying to teach safety education also must qualify for full-time approval in another teaching area.
UNDERGRADUATE CURRICULA IN THE COLLEGE OF EDUCATION

Undergraduate students planning to major in elementary education or industrial education will enroll in the College of Education. Students may also qualify through the College of Education for approval to teach safety and driver education; such students must also qualify for approval to teach in some major area of work (see Index, Industrial Education, Courses and Programs.)

Each student will have a faculty adviser in his chosen curriculum to aid in planning his program.

Curriculum in Elementary Education

The curriculum in elementary education is planned for students preparing to teach in grades kindergarten through six. For additional information see Index, Courses and Programs.

Total credits required—192.

I. General Education ..........................................................75 credits

A. Biological Sciences ..............................................................9-21 credits

- Principles of Biology, Biol. 101 ........................................3 credits
- Elementary Human Physiology and Anatomy, Zool. 155 ..........5 credits
- Options—biology, botany, nutrition and zoology

B. Communicative Arts .........................................................14-21 credits

- Language in Composition and Reading, Engl. 104, 105 ..............8 credits
- Fundamentals of Speech, Sp. 211 ........................................3 credits
- Options—English, speech, journalism

C. Humanities ........................................................................15-21 credits

- Introduction to Literature, Engl. 201 ....................................3 credits
- History—Any combination ......................................................6 credits
- Options—art, history, literature, music, foreign language, philosophy

D. Physical Sciences and Mathematics ..................................17-21 credits

- World Geography, Geog. 201 ............................................3 credits
- Mathematical Concepts, Math. 190, and 191 or 192. ..............6 credits
- Options—Select two: chemistry, geology, physics

E. Social Science .....................................................................15-21 credits

- Principles of Economics, Econ. 241 .....................................3 credits
- American Government, Pol.S. 215 .....................................3 credits
- General Psychology, Psych. 101 ..........................................3 credits
- Introduction to Sociology, Soc. 134 .....................................3 credits
- Options—anthropology, economics, political science, psychology, sociology

II. Professional Education Core .............................................10 credits

- Foundations of American Education, Edu. 204 .......................3 credits
- Methods of Teaching (Audio-Visual Laboratory), Educ. 305B ......1 credit
- Developmental Psychology, Psych. 230 ...............................3 credits
- Educational Psychology, Psych. 333 ....................................3 credits

III. Courses in the Major ..........................................................57 credits

A. Child Development ..............................................................10 credits

- Principles of Child Development, C.D 236 ............................3 credits
- Development and Guidance in Later Childhood, C.D 337 .........3 credits
- Guidance of Children, C.D 460 ............................................4 credits

B. Elementary Education .........................................................19 credits

- Principles of Teaching in Elementary Schools, EI.Ed. 344A and EI.Ed. 3448 (laboratory) ... 3 credits
- The Teaching of Reading, EI.Ed. 375 ....................................6 credits
Elementary Education Methods I, EI.Ed. 445  
(language arts and social studies) ........................................... 6 credits
Elementary Education Methods II, EI.Ed. 446  
(mathematics—science) .......................................................... 4 credits

C. Student Teaching ............................................................... 16 credits
Student Teaching in Primary Grades, Educ. 467C ...................... 8 credits
Student Teaching in the Intermediate Grades, Educ. 467D ........... 8 credits

D. Related Methods ............................................................... 9 credits
Options—Music 365, P E W 470, Sp 375, A.A 200, EI.Ed. 447, 455, 456

E. Related Courses ............................................................... 3 credits
Options—F E 270; C D 240, 336, 366, Sp. 362

IV. Area of Concentration ..................................................... 24 credits
Selection of courses from broad areas such as art, communications, disadvantaged child, exceptional child, home economics, languages, mathematics, music, physical education, sciences, and social studies. Student must select from one area.

V. Electives ............................................................................ 22 credits

VI. Physical Education .......................................................... 3 credits

VII. Library Instruction, Lib. 160 ............................................. 1 credit

VIII. Orientation ................................................................. R
Freshman Orientation, EI.Ed. 100 ............................................. R
Sophomore Orientation, EI.Ed. 200 .......................................... R
Transfer Orientation, EI.Ed. 300 ............................................. R

Curriculum in Industrial Education

The curriculum in Industrial Education is planned for students preparing to teach or to enter industry. The teaching option provides preparation for teachers of industrial arts or vocational-technical education. The industrial option prepares students for employment in business or industry, particularly in personnel work, selling, communication, contracting and construction, maintenance, or production.

Total credits required—192.
For additional information, see Index.

I. General Education ............................................................ 75 credits
A. Physical Science and Mathematics .................................... 17-21 credits
  General Chemistry, Chem. 140 and 140L, or 141 and 141L .......... 4 credits
  Mathematics ........................................................................ 9 credits
  General Physics, Phys. 111 ............................................... 4 credits

B. Social Studies ..................................................................... 15-21 credits
  Principles of Economics, Econ. 241, 242 ............................. 6 credits
  American Government, Pol.S. 215 .................................... 3 credits
  General Psychology, Psych. 101 ........................................ 3 credits
  Introduction to Sociology, Soc. 134 ................................. 3 credits

C. Biological Science .......................................................... 9-21 credits
  Principles of Biology, Biol. 101 ........................................ 3 credits
  Elementary Human Physiology and Anatomy, Zool. 155 ........ 5 credits
  Electives (May take Biol. 101A for 2 credits) ....................... 1 credit
D. Humanities

- History ................................................................. 6 credits
- Electives (applied art, history, literature, music, philosophy) ........... 3 credits

E. Communicative Arts

- Language in Composition and Reading, Engl. 104, 105 .................... 8 credits
- Fundamentals of Speech, Sp. 211 .............................................. 3 credits
- Electives ............................................................................... 3 credits

II. Industrial Education Core

- Technology and Application of Finishing Materials, I Ed. 105 .......... 3 credits
- Exploration and Fundamental Fabrication of Wood, I Ed. 106 ......... 3 credits
- Introduction to Industrial Education, I Ed. 110 ............................ 3 credits
- Drafting I, I Ed. 121 ............................................................. 3 credits
- Drafting II, I Ed. 122 ................................................................ 3 credits
- Drafting III, I Ed. 123 ............................................................ 3 credits
- Advanced Techniques of Wood Fabrication, I Ed. 205 ..................... 3 credits
- Industrial Arts Design, I Ed. 220 .............................................. 3 credits
- Sheet Metal Fabrication, I Ed. 232 ............................................ 3 credits
- Basic Metal Processes, I Ed. 234 ............................................. 3 credits
- Machine Metals I, I Ed. 236 .................................................... 3 credits
- Electricity I, I Ed. 251 ............................................................. 3 credits
- Electricity II, I Ed. 253 ............................................................ 3 credits
- Power Mechanics—An Introduction, I Ed. 260 ............................ 3 credits
- Power Mechanics—Internal Combustion Engines, I Ed. 261 .......... 3 credits
- Power Mechanics—The Automobile, I Ed. 262 ............................ 3 credits
- School Laboratory Safety, I Ed. 310 .......................................... 3 credits
- Electronics I, I Ed. 357 .......................................................... 3 credits
- Introduction to Industrial Plastics, I Ed. 370 ................................ 3 credits
- Faculty Planning and Organization, I Ed. 410 ............................... 3 credits
- Machine Construction, A. E. 359 ............................................. 3 credits

Note: Students entering industrial education as freshmen will generally enroll for the following courses: I Ed. 105, 106, 110, 121, 122, 123, 205, 220, 234; Engl. 104, 105; mathematics; and physical education.

III. Options

A. Teaching Option

1. Required ........................................................................... 37-40 credits
- Foundations of American Education, Educ. 204 ............................ 3 credits
- Methods of Teaching, Educ. 305A .......................................... 3 credits
- Methods of Teaching, Educ. 305B .......................................... 1 credit
- Principles of Secondary Education, Educ. 426 ............................ 3 credits
- Modern Materials, Design and Construction, I Ed. 308 (3 cr.)
  or
- Architectural Drafting for industrial Education Teachers, I Ed. 324 (3 cr.)
  or
- Machine Metals II, I Ed. 336 (3 cr.) ....................................... 6 credits required
- Methods of Teaching Industrial Arts, I Ed. 415 ............................ 3 credits
- Observation and Supervised Student Teaching in
  Industrial Education, I Ed. 417 .............................................. 3-12 credits
- Foundations of Vocational and Technical Education, I Ed. 514 ....... 3 credits
- Developmental Psychology, Psych. 230 .................................... 3 credits
- Educational Psychology, Psych. 333 ....................................... 3 credits

2. Electives ............................................................................. 14 credits
B. Industrial Option

1. Required

- Computer Programming, Com.S. 201 .................................. 3 credits
- Labor Economics and Labor Relations, Econ 305 ................. 3 credits
- Business Communication, Engl. 404 (2 cr.)
  or 
  Writing of Reports and Technical Papers, Engl. 414 (3 cr.) .......... 2.3 credits
- Industrial Accounting, I.Ad. 371 ........................................ 3 credits
- Introduction to Industrial Engineering, I.E. 250 .................... 4 credits
- Analytic Geometry and Calculus I, Math. 110 (5 cr.)
  or 
  Principles of Statistics, Stat. 101 (5 cr.) ............................... 5 credits
- Foundations of American Education, Educ. 204 .................. 3 credits
- Industrial Psychology I, Psych. 450 .................................... 3 credits
- Business and Professional Speaking, Sp. 312 (3 cr.)
  or 
  Persuasion, Sp. 327 (3 cr.)
  or 
  Group Discussion, Sp. 317 (3 cr.) ................................. 3 credits

2. Electives ........................................ 22 credits

Students are encouraged to select electives from the following subject matter areas

- Architecture
- Computer Science
- Economics
- English
- Forestry
- Industrial Administration
- Industrial Engineering
- Journalism
- Mathematics
- Physics
- Psychology
- Speech

IV. Physical Education ......................................................... 3 credits

V. Library Instruction (Lib. 160) ........................................ 1 credit
The engineer occupies a uniquely important position in our modern civilization. He has the responsibility for taking the discoveries of basic science and translating them into products, structures, facilities, and services for the use of mankind.

In his professional practice, an engineer may conduct research on problems of fundamental engineering importance; he may develop new materials, structures, machines, or devices; he may design such devices for production; he may develop and design processes and plants for producing raw materials and finished products; he may operate or manage large public utility systems, construction companies, or industrial plants; he may engage in technical sales work; or he may become an engineering teacher. In all of these activities, the engineer must combine imagination, resourcefulness, inventive skill, economic sense, and good judgment in applying his scientific knowledge in the service of mankind. An engineering education is an excellent foundation for any career in our modern civilization where technology is so important.

Objectives of Curricula in Engineering

The broad objectives of engineering education are to develop the student's professional competence and, by breadth of study, to prepare him for participation as a leader in the affairs of his profession, his community, the state, and the nation. Engineering education seeks to develop a capacity for objective and analytical thought. It requires a sound knowledge of English and of the basic sciences of chemistry, physics, mathematics, and economics, as well as the specialized phases of these studies needed for particular fields of engineering. The training is characterized by practice in the analysis and solution of problems and by the application of knowledge to life situations. Since engineers also must deal with problems involving human relations, about one-fifth of the engineering curricula involves the social sciences and the humanities. Special attention is devoted to a development of the student's ability to write and speak effectively.

The curricula in engineering permit, in the outlined four years, a thorough preparation in the basic and engineering sciences and in professional analysis and design. About one-fourth of the total content of each curriculum is devoted to each of these three fields, with five to ten percent of the total made up of options and electives. These proportions meet the requirements recommended by the Engineers' Council for Professional Development, the national accrediting agency.

Registration as a professional engineer is required for many types of engineering positions. Such registration is granted by the individual states after the successful completion of an examination in engineering fundamentals, of four years of experience and of a final examination in engineering practice. The professional curricula at Iowa State University prepare a student for registration, and frequently the first examination can be taken at the University shortly before graduation.

More advanced work in engineering is offered in the postgraduate programs. See the Graduate College section of this Catalog.

The College of Engineering also administers the two-year programs of its Technical Institute in which students are prepared for careers as engineering technicians. For details of these programs and of the requirements for admission to them, see Index, Technical Institute. Opportunities are available in the College of Engineering for a student who has graduated in the upper half of his class from an Iowa State engineering technology program to work toward the bachelor's degree. See Index, Technical Institute.
### Curricula in College of Engineering

<table>
<thead>
<tr>
<th>Professional Engineering Curricula</th>
<th>Graduate Programs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aerospace Engineering</td>
<td>M. Eng., M.S., Ph.D. (joint major)</td>
</tr>
<tr>
<td>Agricultural Engineering</td>
<td>M. Eng., M.S., Ph.D.</td>
</tr>
<tr>
<td>Ceramic Engineering</td>
<td>M. Eng., M.S., Ph.D.</td>
</tr>
<tr>
<td>Chemical Engineering</td>
<td>M. Eng., M.S., Ph.D. (undergraduate only)</td>
</tr>
<tr>
<td>Civil Engineering</td>
<td>M. Eng., M.S., Ph.D.</td>
</tr>
<tr>
<td>Construction Engineering</td>
<td>M. Eng., M.S., Ph.D. (undergraduate only)</td>
</tr>
<tr>
<td>Electrical Engineering</td>
<td>M. Eng., M.S., Ph.D.</td>
</tr>
<tr>
<td>Engineering Mechanics</td>
<td>M. Eng., M.S., Ph.D.</td>
</tr>
<tr>
<td>Engineering Science</td>
<td>M. Eng., M.S., Ph.D.</td>
</tr>
<tr>
<td>Industrial Engineering</td>
<td>M. Eng., M.S., Ph.D.</td>
</tr>
<tr>
<td>Mechanical Engineering</td>
<td>M. Eng., M.S., Ph.D.</td>
</tr>
<tr>
<td>Metallurgy</td>
<td>M.S., Ph.D.</td>
</tr>
<tr>
<td>Nuclear Engineering</td>
<td>M. Eng., M.S., Ph.D.</td>
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<tr>
<td></td>
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</tr>
<tr>
<td>Related Curricula</td>
<td></td>
</tr>
<tr>
<td>Architecture</td>
<td>6 yr. M. Arch.</td>
</tr>
<tr>
<td>Biomedical Engineering</td>
<td>M.S., Ph.D.</td>
</tr>
<tr>
<td>Engineering Operations</td>
<td>(undergraduate only)</td>
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<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Engineering Technology</td>
<td></td>
</tr>
<tr>
<td>Chemical Industries Technology</td>
<td>6 qtr. reg., Assoc. in App. Sci</td>
</tr>
<tr>
<td>Construction Technology</td>
<td>6 qtr. reg. &amp; 8 qtr. Co-op, Assoc. in App. Sci</td>
</tr>
<tr>
<td>Electronics Technology</td>
<td>6 qtr. reg., Assoc. in App. Sci</td>
</tr>
<tr>
<td>Mechanical Technology</td>
<td>6 qtr. reg. &amp; 8 qtr. Co-op, Assoc. in App. Sci</td>
</tr>
</tbody>
</table>

1. Accredited by the Engineers' Council for Professional Development (ECPD).
2. New program. Will apply for accreditation at next inspection.
3. Accredited by the National Architectural Accreditation Board.

### Organization of Curricula

All curricula in engineering are divided into two phases, a basic program and a professional program. The basic program consists primarily of subjects fundamental and common to all branches of engineering and includes chemistry or physics, mathematics, engineering graphics, and English. A student who has adequate high school preparation is expected to complete the basic program in one year. The professional phase of a curriculum includes intensive study in the particular branch of engineering which a student chooses as his major, as well as a continuation of supporting work in mathematics, basic sciences, humanities, and social sciences.

### Preparation for the Engineering Curricula

A student who wishes to complete a particular engineering curriculum in four years (six years in the case of architecture) should present high school credits as follows:

- Four years of English
- One year of physics
- One year of chemistry
- Four years of mathematics, including two years of algebra, one year of geometry, one-half year of trigonometry.

A student not having these prerequisites may still enroll in the College of Engineering, but it may take longer than four years to earn a degree. The basic program in engineering is flexible with respect to time, and courses in the basic program may be adjusted to fit individual needs. A student is expected to complete the requirements of the basic program before proceeding to the professional engineering curriculum of his choice.
Basic Program for Professional Engineering Curricula

The basic (first year) program is much the same for all professional curricula in the College of Engineering, and during the first year a student may transfer from one department to another within the college without undue loss of time. There are some differences, however, and the student who desires to receive the bachelor's degree in minimum time will find it desirable to determine his major department as soon as possible.

The basic program includes:

<table>
<thead>
<tr>
<th>Subject</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mathematics 109, 110, 111</td>
<td>15</td>
</tr>
<tr>
<td>English 104, 105</td>
<td>8</td>
</tr>
<tr>
<td>Engineering Graphics 161, 162</td>
<td>6</td>
</tr>
<tr>
<td>Chemistry 141, 141L</td>
<td>4</td>
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<tr>
<td>Physics 221</td>
<td>5</td>
</tr>
<tr>
<td>Engineering Problems (I.E. 108)</td>
<td>1</td>
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<tr>
<td>Engineering Seminars (Engr. 114, 115,</td>
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<tr>
<td>departmental seminar 100)</td>
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<tr>
<td>Library 102</td>
<td>R</td>
</tr>
<tr>
<td>Department Designated Requirement</td>
<td>6 (minimum)</td>
</tr>
<tr>
<td>Total</td>
<td>45 (minimum)</td>
</tr>
</tbody>
</table>

1Students who are not adequately prepared may have to take Math. 37 and/or Chem. 140, 140L in addition to the courses listed above. Neither Math. 37 nor Chem. 140, 140L may be used to satisfy elective requirements of the various engineering curricula. Students who begin with Math. 37 will take I.E. 104 and 105 in place of I.E. 108.

2Department Designated Requirement

Aerospace Engineering                          | Phys. 222, Socio-Humanistic Elective (3 cr.) |
Agricultural Engineering                       | Chem. 142, 142L, Agron. 154A                 |
Ceramic Engineering                            | Chem. 142, 142L, Free Elective (3 cr.)       |
Construction Engineering                       | Chem. 142, 142L, Pol. S. 215, Soc. 134       |
Chemical Engineering                           | Chem. 142, 142L, Chem. 211                   |
Civil Engineering                              | Chem. 142, 142L, Socio-Humanistic Elective (3 cr.) |
Electrical Engineering                         | Phys. 222, Econ. 241                         |
Engineering Science                            | Chem. 142, 142L, Phys. 222                   |
Industrial Engineering                         | Chem. 142, 142L, Psych. 101                  |
Mechanical Engineering                         | Chem. 142, 142L, Phys. 222                   |
Metallurgy                                     | Chem. 142, 142L, Elective (3 cr.)            |

The student's adviser may require or recommend courses in addition to those specified above if the preparation and progress of the student are such that additional courses are necessary or desirable. Students essentially must complete the basic program and have at least a 2.00 cumulative average before being permitted to enroll in courses offered in the College of Engineering at the 200 level or above.

Physical Education and Reserve Officers Training Corps (ROTC)

In addition to the requirements listed in the various engineering curricula, all students are required to earn 3 credits in physical education. A student is expected to enroll in physical education during his first quarter in the University and to continue enrolling in it each subsequent quarter until the requirement is completed. Credits received in the required physical education courses may not be used as electives in any of the engineering curricula.

At the discretion of each department, up to 6 credits of Basic ROTC and up to 6 credits of Advanced ROTC may be applied toward graduation requirements.

Cooperative Work-study Programs

The College of Engineering offers, through certain of its curricula, cooperative programs in which students may gain practical experience in engineering during college years.

These programs are arranged so that the academic work is taught at the University and
practical experience is gained by working in industry during certain periods each year. The student under a cooperative program receives experience in his chosen profession plus financial return. The company can evaluate the student's potential as a possible future permanent employee. The college gains by the industrial experiences which the cooperative student brings into the classroom.

In general, students under these programs will require one year more to complete the usual curriculum requirements. The first contact with industry usually comes after completion of the first or second year. The college does not guarantee the kind of work or wages but attempts to place students to their best educational and financial advantages.

A student must observe regulations of the employing company and must not expect special treatment. University holidays do not apply to cooperative students, nor are students allowed time off for University activities. A student may not enroll in classes at any educational institution during a period of cooperative employment without University approval.

Those in the cooperative program are considered by the University to be students while they are employed in industry. Such students are subject to University regulations concerning conduct during this period and are liable to dismissal from the University for misconduct on the job. They may continue living in University housing during work periods.

Cooperative students pay no fees to the University during work periods but may attend student activities provided they pay the activity fee.

**Advising System**

The purpose of the advising system in the College of Engineering is to work constructively with the student in developing his individual academic program and to maintain close contact with him during his college career.

The College also offers counseling service during the summer for students planning to enter in the fall. All prospective students are encouraged to attend one of these sessions. Tests given at this time help determine the student's level of achievement and enable his adviser to prepare an appropriate fall quarter program for the student.

**Program in International Studies**

Special training for those interested in employment overseas is provided. See *Index, International Studies*.

**Curriculum in Aerospace Engineering**

Leading to the degree Bachelor of Science. Total credits required—192, plus physical education.

See also *Basic Program* and *Cooperative Programs*.

<table>
<thead>
<tr>
<th>FALL QUARTER</th>
<th>WINTER QUARTER</th>
<th>SPRING QUARTER</th>
</tr>
</thead>
<tbody>
<tr>
<td>Credits</td>
<td>Credits</td>
<td>Credits</td>
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<tr>
<td><strong>Sophomore Year</strong></td>
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<tr>
<td>Aerodynamics I</td>
<td>Aerodynamics II</td>
<td>Performance of Aerospace Vehicles</td>
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<td>Aer. E. 245</td>
<td>Aer. E. 246</td>
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<td>E. M. 274</td>
<td>E. M. 345</td>
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<td>Metallurgy for Engineers</td>
<td>Computer Programming</td>
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<td>Met. 231</td>
<td>Com. S. 201</td>
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<td>Aer. E. 271</td>
<td>Aerospace Laboratory</td>
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<td>Socio-Humanistic Elective 1</td>
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<tr>
<td>Aerospace Laboratory</td>
<td>1</td>
</tr>
<tr>
<td>Mechanics of Materials I</td>
<td>3</td>
</tr>
<tr>
<td>Rigid Body Dynamics</td>
<td>3</td>
</tr>
<tr>
<td>Introduction to Applied Mathematics II</td>
<td>3</td>
</tr>
<tr>
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**WINTER QUARTER**

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<td>Aerospace Laboratory</td>
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</tr>
<tr>
<td>Stress Analysis and Materials</td>
<td>3</td>
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<tr>
<td>Thermodynamics I</td>
<td>3</td>
</tr>
<tr>
<td>Elective</td>
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**SPRING QUARTER**

<table>
<thead>
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<td>Flight Mechanics I</td>
<td>3</td>
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<tr>
<td>Aerospace Laboratory</td>
<td>1</td>
</tr>
<tr>
<td>Structural Analysis</td>
<td>3</td>
</tr>
<tr>
<td>Reaction Propulsion I</td>
<td>3</td>
</tr>
<tr>
<td>Introduction to Circuits and Instruments</td>
<td>3</td>
</tr>
<tr>
<td>E.E. 441</td>
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<tr>
<td>Socio-Humanistic Elective¹</td>
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**Senior Year**

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<tbody>
<tr>
<td>Senior Projects</td>
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<tr>
<td>Design and Analysis I</td>
<td>3</td>
</tr>
<tr>
<td>Reaction Propulsion II</td>
<td>3</td>
</tr>
<tr>
<td>Fundamentals of Flight Control</td>
<td>3</td>
</tr>
<tr>
<td>Aerodynamic Theory I</td>
<td>3</td>
</tr>
<tr>
<td>Socio-Humanistic Elective¹</td>
<td>3</td>
</tr>
<tr>
<td>Aerospace Seminar</td>
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</tbody>
</table>

¹These courses are to be chosen from the department-approved list of socio-humanistic electives. Pol. S. 215 must be among the courses selected.


³These electives may be technical or nontechnical but must be selected from the department-approved list of courses.

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**Curriculum in Agricultural Engineering**

With options in electric power and processing, farm power and machinery, structures and environment, and soil and water control.

Administered jointly by the College of Agriculture and the College of Engineering.

Leading to the degree Bachelor of Science. Total credits required—199, plus physical education. Six months of practical work in agriculture or industry acceptable to this department is required before graduation.

See also Basic Program and Cooperative Programs.
### Fall Quarter

<table>
<thead>
<tr>
<th>Course and Title</th>
<th>Credits</th>
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<tbody>
<tr>
<td>Agricultural Engineering Concepts I</td>
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<tr>
<td>Materials and Processes</td>
<td>3</td>
</tr>
<tr>
<td>Analytic Geometry and Calculus</td>
<td>5</td>
</tr>
<tr>
<td>Introduction to Classical Physics</td>
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<td><strong>Total</strong></td>
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</tr>
</tbody>
</table>

### Winter Quarter

<table>
<thead>
<tr>
<th>Course and Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agricultural Engineering Concepts II</td>
<td>4</td>
</tr>
<tr>
<td>Elementary Differential Equations</td>
<td>3</td>
</tr>
<tr>
<td>Introduction to Classical Physics</td>
<td>5</td>
</tr>
<tr>
<td>Elementary Organic Chemistry</td>
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### Spring Quarter

<table>
<thead>
<tr>
<th>Course and Title</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>Agricultural Engineering Concepts III</td>
<td>4</td>
</tr>
<tr>
<td>Introduction to Applied Mathematics I</td>
<td>3</td>
</tr>
<tr>
<td>Statics of Engineering</td>
<td>3</td>
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<tr>
<td>Socio-Humanistic Electives</td>
<td>3</td>
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### Sophomore Year

<table>
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<th>Credits</th>
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<tbody>
<tr>
<td>Introduction to Circuits and Instruments</td>
<td>4</td>
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<tr>
<td>Computer Programming</td>
<td>3</td>
</tr>
<tr>
<td>Materials Laboratory</td>
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</tr>
<tr>
<td>Principles of Economics</td>
<td>3</td>
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<tr>
<td>Strength of Materials</td>
<td>5</td>
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<tr>
<td>Seminar</td>
<td>R</td>
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<td><strong>Total</strong></td>
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</table>

### Junior Year

<table>
<thead>
<tr>
<th>Course and Title</th>
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<tbody>
<tr>
<td>Thermodynamics I</td>
<td>4</td>
</tr>
<tr>
<td>Agricultural Structures and Environment</td>
<td>4</td>
</tr>
<tr>
<td>Principles of Economics</td>
<td>3</td>
</tr>
<tr>
<td>Particle Dynamics</td>
<td>3</td>
</tr>
<tr>
<td>Option or Electives</td>
<td>3</td>
</tr>
<tr>
<td>Seminar</td>
<td>R</td>
</tr>
<tr>
<td><strong>Total</strong></td>
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### Senior Year

<table>
<thead>
<tr>
<th>Course and Title</th>
<th>Credits</th>
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<tbody>
<tr>
<td>Electrical Energy Applications in Agriculture</td>
<td>4</td>
</tr>
<tr>
<td>Mechanics of Fluids</td>
<td>4</td>
</tr>
<tr>
<td>Option or Electives</td>
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<tr>
<td>Introduction to Statistics</td>
<td>3</td>
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<tr>
<td>Seminar</td>
<td>R</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>17</strong></td>
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</tbody>
</table>

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1. In the junior and senior years the student will elect one of the options and take the courses listed in the selected option.

2. Socio-humanistic sequences are to be chosen from the department-approved list.
Options

**Electric Power and Processing**

<table>
<thead>
<tr>
<th>Subject</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>Mechanical Behavior of Metals</td>
<td>3</td>
</tr>
<tr>
<td>Machine Design I</td>
<td>4</td>
</tr>
<tr>
<td>Machine Design II</td>
<td>3</td>
</tr>
<tr>
<td>Heat Transfer</td>
<td>3</td>
</tr>
<tr>
<td>Refrigeration and Air Conditioning</td>
<td>3</td>
</tr>
<tr>
<td>Rigid Body Dynamics</td>
<td>3</td>
</tr>
<tr>
<td>Crop Conditioning and Storage</td>
<td>3</td>
</tr>
<tr>
<td>Properties and Processing of Agricultural Materials</td>
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**Soil and Water Control**

<table>
<thead>
<tr>
<th>Subject</th>
<th>Credits</th>
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<tbody>
<tr>
<td>Hydrology</td>
<td>3</td>
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<tr>
<td>Analysis of Statically Determinate</td>
<td>3</td>
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<tr>
<td>Structures</td>
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</tr>
<tr>
<td>Analysis of Statically Indeterminate</td>
<td>4</td>
</tr>
<tr>
<td>Structures</td>
<td></td>
</tr>
<tr>
<td>Reinforced Concrete Design</td>
<td>3</td>
</tr>
<tr>
<td>Heat Transfer</td>
<td>3</td>
</tr>
<tr>
<td>Refrigeration and Air Conditioning</td>
<td>3</td>
</tr>
<tr>
<td>Principles of Livestock Waste Management</td>
<td>4</td>
</tr>
<tr>
<td>Properties and Processing of Agricultural Materials</td>
<td>3</td>
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<tr>
<td>Advanced Agricultural Structures and Environment</td>
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**Structures and Environment**

<table>
<thead>
<tr>
<th>Subject</th>
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<tbody>
<tr>
<td>Analysis of Statically Determinate</td>
<td>3</td>
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<tr>
<td>Structures</td>
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<tr>
<td>Analysis of Statically Indeterminate</td>
<td>4</td>
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<td>Structures</td>
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<tr>
<td>Reinforced Concrete Design</td>
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<td>Heat Transfer</td>
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<tr>
<td>Refrigeration and Air Conditioning</td>
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<tr>
<td>Principles of Livestock Waste Management</td>
<td>4</td>
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<tr>
<td>Properties and Processing of Agricultural Materials</td>
<td>3</td>
</tr>
<tr>
<td>Advanced Agricultural Structures and Environment</td>
<td>4</td>
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**Farm Power and Machinery**

<table>
<thead>
<tr>
<th>Subject</th>
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<tbody>
<tr>
<td>Mechanical Behavior of Metals</td>
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<td>Machine Design I</td>
<td>4</td>
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<td>3</td>
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<td>Machine Design III</td>
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<td>Rigid Body Dynamics</td>
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<td>Power and Control Hydraulics</td>
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<td>Properties and Processing of Agricultural Materials</td>
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**Curriculum in Architecture**

This is a six-year academic program consisting of:

1. A four-year undergraduate program in architecture leading to the degree Bachelor of Arts.
2. A recommended year of cooperative studies with industry.
3. A two-year graduate program leading to the degree Master of Architecture.

The four-year program in architecture is designed to qualify graduates to assume productive and responsible careers in businesses and industries related to architecture, and leads
to the degree Bachelor of Arts, a nonprofessional degree. It consists of a two-year prearchitecture program (95 credits), and a two-year undergraduate architectural program (99 credits). Professional electives are offered, permitting students to study, in depth, fields relevant to architecture in which they possess unique interest and qualifications. Total credits required—194, plus physical education.

Qualified students holding the degree Bachelor of Arts in architecture or its equivalent may be admitted to the two-year graduate program leading to the first professional degree, Master of Architecture. This program is designed to educate professional architects to work effectively within contemporary constraints, to comprehend continuing changes within our society, and to formulate concepts of a better human environment.

It is recommended that students holding the degree Bachelor of Arts in architecture and planning to pursue the degree Master of Architecture spend one year in a cooperative program with approved industries before undertaking further architectural studies.

Ninety credits subsequent to the degree Bachelor of Arts are required to attain the degree Master of Architecture.

**Prearchitecture Program**

<table>
<thead>
<tr>
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<th>WINTER QUARTER</th>
<th>SPRING QUARTER</th>
</tr>
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<tbody>
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<td>Credits</td>
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<td><strong>Second Year</strong></td>
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<td>Phys. 113</td>
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<tr>
<td>Arch. 238</td>
<td>Arch. 239</td>
<td></td>
</tr>
</tbody>
</table>

1 Not in architecture. A balanced distribution of courses should be chosen, approved by the student's adviser.

2 Prearchitecture and transfer students may, with the consent of their adviser and the head of the Department of Architecture, substitute equivalent credits in art or architectural history for orientation.

3 For students who may wish to include advanced technical courses among their professional electives, the substitution of the following sequences is suggested: Math. 110, 111, 112; Phys. 221, 222, 223.
### Undergraduate Architecture Program

#### Fall Quarter

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>Design I</td>
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</tr>
<tr>
<td>History of Architecture I</td>
<td>3</td>
</tr>
<tr>
<td>Architectural Graphics I</td>
<td>3</td>
</tr>
<tr>
<td>Architectural Technologies I</td>
<td>3</td>
</tr>
<tr>
<td>Scalar Statics</td>
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#### Winter Quarter

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>Design I</td>
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</tr>
<tr>
<td>History of Architecture I</td>
<td>3</td>
</tr>
<tr>
<td>Architectural Graphics II</td>
<td>3</td>
</tr>
<tr>
<td>Architectural Technologies I</td>
<td>3</td>
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<tr>
<td>Mechanics of Materials I</td>
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</table>

#### Spring Quarter

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>Design I</td>
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<tr>
<td>History of Architecture I</td>
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</tr>
<tr>
<td>Architectural Graphics III</td>
<td>3</td>
</tr>
<tr>
<td>Architectural Technologies I</td>
<td>3</td>
</tr>
<tr>
<td>Analysis of Statically Determine Structures</td>
<td>3</td>
</tr>
<tr>
<td>C.E. 331A</td>
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</tbody>
</table>

#### Third Year

1. Not in architecture. A balanced distribution of courses should be chosen, approved by the student's adviser.
2. Professional elective: A sequence of courses, relevant to professional development, approved by the student's adviser and the department head.

#### Fourth Year

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design II</td>
<td>4</td>
</tr>
<tr>
<td>Architectural Technologies II</td>
<td>3</td>
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<tr>
<td>Analysis of Statically Indeterminate Structures</td>
<td>4</td>
</tr>
<tr>
<td>E.E. 332A</td>
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<tr>
<td>Elective†</td>
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#### Credits Summary

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<tr>
<td>Fall</td>
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<tr>
<td>Winter</td>
<td>16</td>
</tr>
<tr>
<td>Spring</td>
<td>16</td>
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Total Credits: 17
Professional Program

A graduate program leading to the degree Master of Architecture. Credits required for graduation—90.

**FALL QUARTER**

<table>
<thead>
<tr>
<th>Seminar</th>
<th>Arch. 501</th>
<th>R</th>
<th>Seminar</th>
<th>Arch. 502</th>
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<th>R</th>
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<td>Research and Design III</td>
<td>Arch. 515</td>
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**WINTER QUARTER**

| Research and Design IV | Arch. 611 | 7 | Research and Design IV | Arch. 612 | 7 | Research and Design IV | Arch. 613 | 7 |
| Theory of Urban Architecture | Arch. 681 | 2 | Theory of Urban Architecture | Arch. 682 | 2 | Theory of Urban Architecture | Arch. 683 | 2 |
| Elective | 3 | Elective | 3 | Elective | 3 | Elective | 3 |
| Professional Elective | 3 | Professional Elective | 3 | Professional Elective | 3 |
| **Credits** | 15 | **Credits** | 15 | **Credits** | 15 |

**SPRING QUARTER**

| Ceramic Materials Processing | Cer.E. 223 | 4 | High Temperature Technology | Cer.E. 233 | 4 | Computer Programming | Com. S. 201 | 3 |
| Quantitative Analysis | Chem. 211 | 5 | Statics of Engineering | E.M. 274 | 3 |
| Seminar | Cer.E. 202 | R | Seminar | Cer.E. 203 | R |
| Ceramic Materials Processing | Cer.E. 223 | 4 | High Temperature Technology | Cer.E. 233 | 4 | Computer Programming | Com. S. 201 | 3 |
| Quantitative Analysis | Chem. 211 | 5 | Statics of Engineering | E.M. 274 | 3 |
| Seminar | Cer.E. 202 | R | Seminar | Cer.E. 203 | R |
| **Credits** | 17 | **Credits** | 17 | **Credits** | 14 |

1Professional elective A sequence of courses relevant to professional development, approved by the student's adviser and the department head.

Curriculum in Ceramic Engineering

Leading to the degree Bachelor of Science. Total credits required—192, plus physical education.

See also Basic Program.

**FALL QUARTER**

<p>| Ceramic Materials | Cer.E. 221 | 4 | Ceramic Engineering Operations | Cer.E. 222 | 4 | Ceramic Materials Processing | Cer.E. 223 | 4 |
| Analytic Geometry and Calculus III | Math. 112 | 5 | Elementary Differential Equations | Math. 213 | 3 | High Temperature Technology | Cer.E. 233 | 4 |
| Introduction to Classical Physics | Phys. 222 | 5 | Introduction to Classical Physics | Phys. 223 | 5 | Computer Programming | Com. S. 201 | 3 |
| Technical Electives | Seminar | 3 | Seminar | Cer.E. 201 | R | Statics of Engineering | E.M. 274 | 3 |
| Seminar | Cer.E. 202 | R | Ceramic Materials Processing | Cer.E. 223 | 4 |
| <strong>Credits</strong> | 17 | <strong>Credits</strong> | 17 | <strong>Credits</strong> | 14 |</p>
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<tr>
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<th>SPRING QUARTER</th>
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<tr>
<td></td>
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<td>Credits</td>
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<tr>
<td>High Temperature Processes</td>
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<td>Microstructure of Ceramic Materials</td>
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<td>Econ. 241</td>
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<tr>
<td>Physical Chemistry</td>
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<td>Chem. 321</td>
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<tr>
<td>Introduction to Circuits and Instruments¹</td>
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<td>E.E. 441</td>
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<td>Ceramic Industries I</td>
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<td>Cer. E. 401</td>
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<td>Ceramic Industries II</td>
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<tr>
<td>Cer. E. 432</td>
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<td>Ceramic Engineering Design</td>
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<td>Metallurgical Thermochemistry</td>
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<tr>
<td>Seminar</td>
<td>R</td>
<td></td>
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<td>Cer. E. 402</td>
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<tr>
<td></td>
<td>16</td>
<td>16</td>
<td>17</td>
</tr>
</tbody>
</table>

¹Socio-humanistic electives must be department approved. Pol. S. 215 will be among the courses elected.
²E.E. 341, 342, 445 may be substituted for E.E. 441, 445, Technical Elective.
### Curriculum in Chemical Engineering

Leading to the degree Bachelor of Science. Total credits required—196, plus physical education.

See also Basic Program and Cooperative Programs.

<table>
<thead>
<tr>
<th>FALL QUARTER</th>
<th>Credits</th>
<th>WINTER QUARTER</th>
<th>Credits</th>
<th>SPRING QUARTER</th>
<th>Credits</th>
</tr>
</thead>
</table>
| **Sophomore Year**
| Introduction to Chemical Engineering | 3 | Material and Energy Balances | 3 | Chemical Processing | 3 |
| Ch.E. 201 | | Ch.E. 202 | | Ch.E. 210 | |
| Analytic Geometry and Calculus III | 5 | Elementary Differential Equations | 3 | Introduction to Applied Mathematics | 3 |
| Math. 112 | | Math. 213 | | Math. 321 | |
| Introduction to Classical Physics | 5 | Introduction to Classical Physics | 5 | Physical Chemistry | 3 |
| Phys. 222 | | Phys. 223 | | Chem. 321 | |
| Principles of Economics | 3 | Socio-Humanistic Elective | 3 | Fundamentals of Speech | 3 |
| Econ. 241 | | Elective | | Sp. 211 | |
| **Total** | 16 | 17 | 15 | | |

| **Junior Year**
| Multistage Operations | 4 | Momentum Transport Operations | 5 | Junior Inspection Trip | 3 |
| Ch.E. 351 | | Ch.E. 352 | | Ch.E. 300 | |
| Physical Chemistry | 3 | Physical Chemistry | 3 | Energy Transport Operations | 3 |
| Chem. 322 | | Chem. 323 | | Ch.E. 353 | |
| Statics of Engineering | 3 | Laboratory in Physical Chemistry | 1 | Computer Applications in | 1 |
| E.M. 274 | | Chem. 322L | | Chemical Engineering | |
| Organic Chemistry | 3 | Organic Chemistry | 3 | Ch.E. 341 | |
| Chem. 334 | | Chem. 335 | | Chem. 336 | |
| Socio-Humanistic Elective | 3 | Laboratory in Organic Chemistry | 3 | Laboratory in Physical Chemistry | 3 |
| | | Chem. 337 | | Chem. 323L | |
| | | Socio-Humanistic Elective | 3 | Engineering Mechanics | 3 |
| | | | | or | 3 |
| | | | | Electrical Engineering | 3 |
| | | | | or | 3 |
| **Total** | 16 | 17 | 18 | | |

| **Senior Year**
| Technical Seminar | 3 | Technical Seminar | 3 | Technical Seminar | 3 |
| Ch.E. 401 | | Ch.E. 402 | | Ch.E. 403 | |
| Process Control | 3 | Chemical Engineering Laboratory | 2 | Chemical Engineering Laboratory | 2 |
| Ch.E. 435 | | Ch.E. 451 | | Ch.E. 452 | |
| Process Control Laboratory | 2 | Chemical Engineering Thermodynamics | 2 | Chemical Reactor Design | 3 |
| Ch.E. 450 | | Ch.E. 462 | | Ch.E. 463 | |
| Mass Transport Operations | 2 | Chemical Engineering Design | 3 | Chemical Engineering Design | 3 |
| Ch.E. 454 | | Ch.E. 472 | | Ch.E. 473 | |
| Chemical Engineering Thermodynamics | 3 | Electrical Engineering | 4 | Electrical Engineering | 4 |
| Ch.E. 461 | | or | | or | |
| Ch.E. 471 | | or | | or | |
| Socio-Humanistic Elective | 3 | Socio-Humanistic Elective | 3 | Socio-Humanistic Elective | 3 |
| | | Elective | | Elective | |
| **Total** | 17 | 17 | 15 | | |

1These electives are to be chosen from the department-approved list of socio-humanistic electives.
2Advanced ROTC credit may be substituted for this.
3Math. 322 may be substituted for this.
4E.M. 325, 326, 345, 346 or any electrical engineering course.
Curriculum in Civil Engineering

Leading to the degree Bachelor of Science. Total credits required—199, plus physical education.

See also Basic Program and Cooperative Programs.

For those interested in construction engineering a curriculum is provided which leads to the degree Bachelor of Science in construction engineering. For particulars, consult the professor in charge, construction engineering curriculum. See Construction Engineering, Courses and Programs.

<table>
<thead>
<tr>
<th>FALL QUARTER</th>
<th>Credits</th>
<th>WINTER QUARTER</th>
<th>Credits</th>
<th>SPRING QUARTER</th>
<th>Credits</th>
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<tbody>
<tr>
<td>Elementary Surveying C.E. 211</td>
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<td>Photogrammetry, Mapping, and Land Surveying C.E. 212</td>
<td>3</td>
<td>Route and Higher Surveying C.E. 213</td>
<td>3</td>
</tr>
<tr>
<td>Introduction to Statistics Stat. 105</td>
<td>3</td>
<td>Statics of Engineering E.M. 274</td>
<td>3</td>
<td>Geology for Engineers Geol. 301</td>
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<tr>
<td>Professional Development C.E. 394</td>
<td>R</td>
<td>Socio-Humanistic Elective¹</td>
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<td>Socio-Humanistic Elective¹</td>
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<tr>
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<td><strong>17</strong></td>
<td><strong>17</strong></td>
<td><strong>17</strong></td>
<td><strong>17</strong></td>
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</tbody>
</table>

| Computer Programming Com. S. 201 | 3 | Soil and Aggregate Materials Laboratory C.E. 361 | 3 | Design of Concretes and Stabilized Soil Systems C.E. 362 | 3 |
| Analysis of Statically Determinate Structures C.E. 331 | 3 | Sanitary Engineering I C.E. 425 | 3 | Analysis for Engineering Economy I.E. 304 | 3 |
| Soil Engineering C.E. 360 | 3 | Analysis of Statically Indeterminate Structures C.E. 432 | 4 | Structural Steel Design C.E. 433 | 3 |
| Professional Development C.E. 395 | R | Planning of Transportation Facilities C.E. 352 | 3 | Socio-Humanistic Elective¹ | 3 |
| **Junior Year** | **15** | **18** | **18** | **18** | **18** |
### Curriculum in Construction Engineering

Administered by the Department of Civil Engineering.
Leading to the degree Bachelor of Science. Total credits required—195, plus physical education.
See also Basic Program and Cooperative Programs.

<table>
<thead>
<tr>
<th>FALL QUARTER</th>
<th>Winter Quarter</th>
<th>Spring Quarter</th>
</tr>
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<tbody>
<tr>
<td><strong>Sophomore Year</strong></td>
<td><strong>Credits</strong></td>
<td><strong>Credits</strong></td>
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<tr>
<td>Analysis of Materials and Methods of Construction</td>
<td>3</td>
<td>Construction Specifications</td>
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<td>Analytic Geometry and Calculus III</td>
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<td>C. E. 211</td>
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<td>Econ. 241</td>
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<td></td>
<td>C. E. 212(3 cr.)</td>
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<td></td>
<td>16</td>
<td>17</td>
</tr>
</tbody>
</table>

Shall be chosen from department approved lists. Senior-year electives shall include (1) 9 credits of socio-humansitc studies, (2) 14 credits of basic sciences and engineering sciences as defined below with a minimum of 5 credits in each, (3) 12 credits of technical electives. Basic sciences must be selected in mathematics, statistics, chemistry, or physics. The engineering science course list will include courses in thermodynamics, heat mass and momentum transfer, electrical theory, materials, simultude, systems analysis, and mechanics. One course in a life science will be permitted in this category. Students appointed to advanced ROTC may substitute 6 credits of advanced ROTC for 6 credits of technical electives.
<table>
<thead>
<tr>
<th>FALL QUARTER</th>
<th>WINTER QUARTER</th>
<th>SPRING QUARTER</th>
</tr>
</thead>
<tbody>
<tr>
<td>Credits</td>
<td>Credits</td>
<td>Credits</td>
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<tr>
<td><strong>Junior Year</strong></td>
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<tr>
<td>Contractors Organization</td>
<td>Real Estate Finance</td>
<td>Construction Planning and Progress Scheduling I</td>
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<td>Con.E. 355 (3 cr.)</td>
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<td>Soils and Aggregate</td>
<td>Structural Steel Design</td>
</tr>
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<td>C.E. 331</td>
<td>Materials Laboratory</td>
<td>C.E. 433</td>
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<td>Soil Engineering</td>
<td>Engineering Materials</td>
<td>Introduction to Statistics</td>
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<tr>
<td>C.E. 360</td>
<td>E.M. 354</td>
<td>Stat. 105</td>
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<td>Computer Programming</td>
<td>Analysis of Statically Indeterminate Structures</td>
<td>Analysis for Engineering Economy</td>
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<td>Principles of Accounting</td>
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<td><strong>Senior Year</strong></td>
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<td>Construction Progress Scheduling III</td>
<td>Special Problems in Construction Engineering</td>
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<td>Reinforced Concrete Design</td>
<td>Electives¹</td>
<td>Writing of Reports and Technical Papers</td>
</tr>
<tr>
<td>C.E. 434</td>
<td>13</td>
<td>Engl. 414</td>
</tr>
<tr>
<td>Fundamentals of Speech</td>
<td>3</td>
<td>Electives¹</td>
</tr>
<tr>
<td>Sp. 211</td>
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<td>9</td>
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<tr>
<td>Computer-Oriented</td>
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<td></td>
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<tr>
<td>Business Data Systems I</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Com.S. 441</td>
<td>3</td>
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<tr>
<td>Electives¹</td>
<td>4</td>
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</tr>
<tr>
<td></td>
<td></td>
<td>15</td>
</tr>
</tbody>
</table>

¹For students emphasizing building construction
²For students emphasizing heavy construction
³Electives to include (minimum):

9 credits socio-humanistics (12 credits for heavy construction emphasis)
9 credits basic sciences and engineering sciences (at least 6 credits in engineering science)
12 credits technical or business and management (at least 3 credits in business and management)

For students emphasizing building construction the following courses must be included within the electives: M.E. 406, 407, Arch. 444

For students emphasizing heavy construction the following course must be included within the electives: C.E. 362
### Curriculum in Electrical Engineering

Leading to the degree Bachelor of Science. Total credits required—193, plus physical education.

See also Basic Program and Cooperative Programs.

<table>
<thead>
<tr>
<th>Fall Quarter</th>
<th>Credits</th>
<th>Winter Quarter</th>
<th>Credits</th>
<th>Spring Quarter</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sophomore Year</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Basic Electric Circuits I</td>
<td>3</td>
<td>Basic Electric Circuits II</td>
<td>3</td>
<td>Electronics Engineering</td>
<td>4</td>
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<tr>
<td>E.E. 205</td>
<td></td>
<td>E.E. 206</td>
<td></td>
<td>E.E. 374</td>
<td></td>
</tr>
<tr>
<td>Introduction to Classical Physics</td>
<td>5</td>
<td>Electrical Instrumentation and Experimentation I</td>
<td>2</td>
<td>Electrical Instrumentation and Experimentation II</td>
<td>2</td>
</tr>
<tr>
<td>Phys. 223</td>
<td></td>
<td>E.E. 231</td>
<td></td>
<td>E.E. 232</td>
<td></td>
</tr>
<tr>
<td>Analytic Geometry and Calculus III</td>
<td>5</td>
<td>Elementary Differential Equations</td>
<td>3</td>
<td>Introduction to Applied Mathematics I</td>
<td>3</td>
</tr>
<tr>
<td>Math. 112</td>
<td></td>
<td>Math. 213</td>
<td></td>
<td>Math. 321</td>
<td></td>
</tr>
<tr>
<td>Principles of Economics</td>
<td>3</td>
<td>Statics of Engineering</td>
<td>3</td>
<td>Electric and Magnetic Field Theory I</td>
<td>4</td>
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<tr>
<td>Econ. 242</td>
<td></td>
<td>E.M. 274</td>
<td></td>
<td>E.E. 313</td>
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<tr>
<td></td>
<td></td>
<td>Computer Programming</td>
<td>3</td>
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<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Com.S. 201</td>
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<tr>
<td><strong>Senior Year</strong></td>
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</tr>
<tr>
<td>Technical Electives</td>
<td>10</td>
<td>Technical Electives</td>
<td>10</td>
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<tr>
<td>Electives</td>
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<tr>
<td>Socio-Humanistic Elective</td>
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<td>Socio-Humanistic Elective</td>
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<td>Socio-Humanistic Elective</td>
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<tr>
<td><strong>Junior Year</strong></td>
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<td>Modern Physics</td>
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<td>3</td>
<td>Modern Physics</td>
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<tr>
<td>Phys. 301</td>
<td></td>
<td>Phys. 302</td>
<td></td>
<td>Phys. 303</td>
<td></td>
</tr>
<tr>
<td>Electronics Engineering</td>
<td>4</td>
<td>Electronics Engineering</td>
<td>4</td>
<td>Introduction to Numerical Techniques for Computers</td>
<td>3</td>
</tr>
<tr>
<td>E.E. 375</td>
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<td>E.E. 376</td>
<td></td>
<td>Math. 406</td>
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<td>Electromechanical Devices E.E. 317</td>
<td>4</td>
<td>Socio-Humanistic Elective</td>
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<td></td>
<td></td>
<td>Socio-Humanistic Elective</td>
<td>3</td>
<td>American Government Pol.S. 215</td>
<td>3</td>
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<td></td>
<td></td>
<td></td>
<td>Seminar E.E. 300</td>
<td>R</td>
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<tr>
<td><strong>Senior Year</strong></td>
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<td></td>
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<tr>
<td>Technical Electives</td>
<td>10</td>
<td>Technical Electives</td>
<td>10</td>
<td>Technical Electives</td>
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<td>Electives</td>
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<td>Electives</td>
<td>3</td>
<td>Electives</td>
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<tr>
<td>Socio-Humanistic Elective</td>
<td>3</td>
<td>Socio-Humanistic Elective</td>
<td>3</td>
<td>Socio-Humanistic Elective</td>
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<tr>
<td></td>
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<td></td>
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</tr>
</tbody>
</table>

1. These electives are to be chosen from the department-approved list of socio-humanistic sequences.
2. These electives may be either technical or nontechnical, but must be taken from the department-approved list of electives.
3. Students appointed to advanced military training (third and fourth year) may omit 6 credits from this elective group.
4. All students must take at least 22 credits of electrical engineering technical electives. The recommended list includes: 404, 410, 411, 412, 421, 422, 423, 425, 426, 427, 428, 431, 456, 452, 455, 465, 466, 467, 475, 505, 527. Electrical Engineering 500 level courses may also be elected by qualified undergraduates. Students who plan to enter graduate school and major in electrical engineering should take nine courses from the list of electrical engineering technical electives, preferably three courses each quarter of the year. Students who do not plan to do graduate work in electrical engineering may take a portion of their technical electives outside the Electrical Engineering Department, providing they are chosen from the department-approved list of such electives.
Curriculum in Engineering Operations

Administered by the Department of Industrial Engineering.
Leading to the degree Bachelor of Science. Total credits required—180, plus physical education.
See also Cooperative Programs.
The curriculum consists of a basic core of required courses in the sciences, engineering, and management to which are added 75 credits of elective courses in the specific categories of engineering, socio-humanistics, management, and preliminary supporting subjects. Within this framework, a student may specialize to almost any degree he wishes for a specific occupational objective. Many students choose to work toward the specializations indicated below.

SPECIALIZATIONS
Production Management
Emphasis on direction of all phases of the production process.

Manufacturing Processes
Emphasis on production considerations in selection and specification of manufacturing equipment. Functional characteristics of equipment related to production.

Technical Sales
Provides a background for selling products of a technical nature.

Prelaw
Preparation for graduate work in corporate or patent law.

Operations Research
Development of mathematical concepts and models concerned with decision making in engineering and management.

SPECIAL PROGRAMS
To meet special needs, programs are available in the following (See Index):
  Program in International Studies
  Program in Engineering Journalism
  Program in Engineering for Officer Education
  Program in Surveying and Mapping
  Program for Technical Institute Graduates

Required Courses

<table>
<thead>
<tr>
<th>Basic Sciences</th>
<th>Communication Skills</th>
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</thead>
<tbody>
<tr>
<td>Math. 109, 110, 111, 112</td>
<td>E.Gr. 161, 162</td>
</tr>
<tr>
<td>Chem. 141, 141L, 142, 142L</td>
<td>Engl. 104, 105</td>
</tr>
<tr>
<td>Phys. 221, 222, 223</td>
<td>Sp. 211, Engl. 414</td>
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<td></td>
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<td></td>
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</tr>
<tr>
<td>Socio-Humanistic Courses</td>
<td>Miscellaneous</td>
</tr>
<tr>
<td>Psych. 101</td>
<td>I.E. 108, 109</td>
</tr>
<tr>
<td>Econ. 241, 242</td>
<td>I.E. 480 or I.Ad. 365A</td>
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<tr>
<td>Pol.S. 215</td>
<td>I.Ad. 384</td>
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<tr>
<td></td>
<td>Lib. 102, Engr. 114, 115,</td>
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<tr>
<td></td>
<td>(departmental seminar 100)</td>
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<tr>
<td></td>
<td>I.E. 293, 393</td>
</tr>
<tr>
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<td></td>
</tr>
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</table>

43

43

20

9
## Group Requirements

Course combinations for each student should be integrated toward a vocational objective. Each student's choice of courses in the following groups must be approved in advance by the head of the Department of Industrial Engineering.

<table>
<thead>
<tr>
<th>Group</th>
<th>Minimum Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engineering science, engineering mechanics, 9; electrical engineering, 8; measurements, 3</td>
<td>20</td>
</tr>
<tr>
<td>Sequences in an engineering area (300 level or above)</td>
<td>27</td>
</tr>
<tr>
<td>Supporting work (basic and engineering sciences)</td>
<td>15</td>
</tr>
<tr>
<td>Management, production, business or sales courses (300 level or above, in I.Ad. or I.E.)</td>
<td>15</td>
</tr>
<tr>
<td>Socio-humanistic sequences</td>
<td>18</td>
</tr>
<tr>
<td>Elective</td>
<td>1</td>
</tr>
</tbody>
</table>

## Curriculum in Engineering Science

Administered by the Department of Nuclear Engineering. Leading to the degree Bachelor of Science. Total credits required—198, plus physical education.

See also Basic Program and Cooperative Programs.

<table>
<thead>
<tr>
<th>Fall Quarter</th>
<th>Winter Quarter</th>
<th>Spring Quarter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Credits</td>
<td>Credits</td>
<td>Credits</td>
</tr>
</tbody>
</table>

### Sophomore Year

<table>
<thead>
<tr>
<th>Subject</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Analytic Geometry and Calculus III</td>
<td>5</td>
</tr>
<tr>
<td>Math. 112</td>
<td></td>
</tr>
<tr>
<td>Introduction to Classical Physics</td>
<td>5</td>
</tr>
<tr>
<td>Phys. 223</td>
<td></td>
</tr>
<tr>
<td>Physical Chemistry</td>
<td>3</td>
</tr>
<tr>
<td>Chem. 321</td>
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<tr>
<td>Foreign Language</td>
<td>4</td>
</tr>
<tr>
<td>Socio-Humanistic Elective</td>
<td>3</td>
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<tr>
<td>Total</td>
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</tbody>
</table>

### Junior Year

<table>
<thead>
<tr>
<th>Subject</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction to Applied Mathematics II</td>
<td>3</td>
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<tr>
<td>Math. 322</td>
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</tr>
<tr>
<td>Particle Dynamics</td>
<td>3</td>
</tr>
<tr>
<td>E. M. 345</td>
<td></td>
</tr>
<tr>
<td>Introduction to Circuits and Instruments</td>
<td>4</td>
</tr>
<tr>
<td>E. E. 441</td>
<td></td>
</tr>
<tr>
<td>Modern Physics</td>
<td>3</td>
</tr>
<tr>
<td>Phys. 301</td>
<td></td>
</tr>
<tr>
<td>Socio-Humanistic Elective</td>
<td>3</td>
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<tr>
<td>Total</td>
<td>16</td>
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</table>

<table>
<thead>
<tr>
<th>Subject</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engineering Materials</td>
<td>4</td>
</tr>
<tr>
<td>E. Sci. 351</td>
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</tr>
<tr>
<td>Mechanics of Fluids</td>
<td>4</td>
</tr>
<tr>
<td>E. M. 378</td>
<td></td>
</tr>
<tr>
<td>Electronic Circuits, Instruments and Systems</td>
<td>4</td>
</tr>
<tr>
<td>E. E. 445</td>
<td></td>
</tr>
<tr>
<td>Modern Physics</td>
<td>3</td>
</tr>
<tr>
<td>Phys. 302</td>
<td></td>
</tr>
<tr>
<td>Socio-Humanistic Elective</td>
<td>3</td>
</tr>
<tr>
<td>Total</td>
<td>18</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Subject</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engineering Materials</td>
<td>4</td>
</tr>
<tr>
<td>E. Sci. 352</td>
<td></td>
</tr>
<tr>
<td>Energy Transport Operations</td>
<td>4</td>
</tr>
<tr>
<td>Ch. E. 353</td>
<td></td>
</tr>
<tr>
<td>Electronic Circuits, Instruments and Systems</td>
<td>4</td>
</tr>
<tr>
<td>E. E. 446</td>
<td></td>
</tr>
<tr>
<td>Modern Physics</td>
<td>3</td>
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<tr>
<td>Phys. 303</td>
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</tr>
<tr>
<td>American Government</td>
<td>3</td>
</tr>
<tr>
<td>Pol. S. 215</td>
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<td>Total</td>
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</table>
### Senior Year

<table>
<thead>
<tr>
<th></th>
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<th>Credits</th>
<th>WINTER QUARTER</th>
<th>Credits</th>
<th>SPRING QUARTER</th>
<th>Credits</th>
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<tbody>
<tr>
<td><strong>Engineering Analysis</strong></td>
<td>E.Sci. 481</td>
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<td>Engineering Analysis</td>
<td>E.Sci. 482</td>
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<td>Engineering Analysis</td>
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<tr>
<td><strong>Engineering Materials</strong></td>
<td>E.Sci. 353</td>
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<td>Engineering Science Elective(^1)</td>
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<td>Engineering Science Elective(^1)</td>
</tr>
<tr>
<td><strong>Elective(^1)</strong></td>
<td>3</td>
<td>3</td>
<td>Computer Programming</td>
<td>Com.S. 201</td>
<td>3</td>
<td>Engineering Design</td>
</tr>
<tr>
<td><strong>Mass Transport Operations</strong></td>
<td>Ch.E. 454</td>
<td>3</td>
<td>Socio-Humanistic Elective(^1)</td>
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<tr>
<td><strong>Socio-Humanistic Elective(^1)</strong></td>
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<td>3</td>
<td></td>
<td></td>
<td>17</td>
<td></td>
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</tbody>
</table>

In addition to the courses listed above, each student will be required to include Seminar, E.Sci. 401, 402, 403 in his schedule.

1. These electives are to be chosen from the department-approved list of socio-humanistic sequences.
2. Engineering science electives include courses in mechanics of solids, mechanics of fluids, nature and properties of materials, electrical theory, thermodynamics, and transport phenomena.
3. May be omitted by students in advanced ROTC.
## Curriculum in Industrial Engineering

Leading to the degree Bachelor of Science. Total credits required—193, plus physical education.

See also Basic Program and Cooperative Programs.

<table>
<thead>
<tr>
<th>FALL QUARTER</th>
<th>WINTER QUARTER</th>
<th>SPRING QUARTER</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sophomore Year</strong></td>
<td><strong>Sophomore Year</strong></td>
<td><strong>Sophomore Year</strong></td>
</tr>
<tr>
<td>Analytic Geometry and Calculus III</td>
<td>Elementary Differential Equations</td>
<td>Linear Algebra</td>
</tr>
<tr>
<td>Math. 112</td>
<td>Math. 213</td>
<td>Math. 205</td>
</tr>
<tr>
<td>Metallurgy for Engineers</td>
<td>Computer Programming</td>
<td>Methods Engineering and Work Measurement</td>
</tr>
<tr>
<td>Met. 231</td>
<td>Com. S. 201</td>
<td>I.E. 273</td>
</tr>
<tr>
<td>Introduction to Industrial Engineering</td>
<td>Fundamentals of Speech</td>
<td>Statics of Engineering</td>
</tr>
<tr>
<td>I.E. 250</td>
<td>Sp. 211</td>
<td>E.M. 274</td>
</tr>
<tr>
<td>Introduction to Classical Physics</td>
<td>Principles of Economics</td>
<td>Principles of Economics</td>
</tr>
<tr>
<td>Phys. 222</td>
<td>Econ. 241</td>
<td>Econ. 242</td>
</tr>
<tr>
<td><strong>Credits</strong></td>
<td><strong>Credits</strong></td>
<td><strong>Credits</strong></td>
</tr>
<tr>
<td>17</td>
<td>17</td>
<td>16</td>
</tr>
</tbody>
</table>

| Junior Year |
| Industrial Accounting | I.E. 312 | I.E. 313 |
| I.A. 371 | | |
| Engineering Science Elective¹ | Engineering Mechanics Elective¹ | Engineering Unit Operations |
| Socio-Humanistic Elective¹ | Engineering Science Elective¹ | Ch. E. 310 |
| Seminar | Socio-Humanistic Elective¹ | Engineering Economy |
| I.E. 391 | Seminar | I.E. 404 |
| | R | |
| **Credits** | **Credits** | **Credits** |
| 16 | 16 | 17 |

| Senior Year |
| Industrial Engineering Design I | Industrial Engineering Design II | Industrial Engineering Electives³ |
| I.E. 441 | I.E. 442 | Electronic Circuits, Instruments and Systems |
| Manpower Management | Introduction to Circuits and Instruments | E.E. 445 |
| I.E. 424 | E.E. 441 | |
| Thermodynamics I | Industrial Engineering Elective² | Elective³ |
| M.E. 321 | Socio-Humanistic Elective¹ | Socio-Humanistic Elective¹ |
| or | | | |
| Thermodynamics | Seminar | | |
| Phys. 304 | R | | |
| Writing of Reports and Technical Papers | | | |
| Engl. 414 | | | |
| Socio-Humanistic Elective¹ | | | |
| **Credits** | **Credits** | **Credits** |
| 17 | 15 | 16 |

¹These electives are to be chosen as sequences with advance approval from department-authorized lists.

²Industrial engineering electives are to be chosen from the following: 407, 416, 420, 421, 423, 425, 426, 443, 448, 462, 480.

³This elective may be from the socio-humanistic, the industrial engineering, or the supporting elective list.
Curriculum in Mechanical Engineering

Leading to the degree Bachelor of Science. Total credits required—198, plus physical education.

See also Basic Program and Cooperative Programs.

<table>
<thead>
<tr>
<th></th>
<th>FALL QUARTER</th>
<th>WINTER QUARTER</th>
<th>SPRING QUARTER</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Credits</td>
<td>Credits</td>
<td>Credits</td>
</tr>
<tr>
<td>Sophomore Year</td>
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<table>
<thead>
<tr>
<th>Analytic Geometry and Calculus III</th>
<th>Math. 213</th>
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</tr>
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<tbody>
<tr>
<td>Math. 112</td>
<td></td>
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</tr>
<tr>
<td>Introduction to Classical Physics</td>
<td>5</td>
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</tr>
<tr>
<td>Phys. 223</td>
<td></td>
<td></td>
</tr>
<tr>
<td>M.E. 251</td>
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<tr>
<td>Socio-Humanistic Elective†</td>
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</tr>
<tr>
<td>Elementary Differential Equations</td>
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<tr>
<td>Math. 213</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Statics of Engineering</td>
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<tr>
<td>E.M. 274</td>
<td></td>
<td></td>
</tr>
<tr>
<td>American Government</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pol. S. 215</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Introduction to Mechanical</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Engineering I</td>
<td></td>
<td></td>
</tr>
<tr>
<td>M.E. 252</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Socio-Humanistic Elective†</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Introduction to Applied</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mechanics of Materials I</td>
<td></td>
<td></td>
</tr>
<tr>
<td>E.M. 325</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Particle Dynamics</td>
<td></td>
<td></td>
</tr>
<tr>
<td>E.M. 345</td>
<td></td>
<td></td>
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<tr>
<td>Principles of Materials Science</td>
<td></td>
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<tr>
<td>Met. 230</td>
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<tr>
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17  16  16
### Junior Year

<table>
<thead>
<tr>
<th>Course</th>
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<tbody>
<tr>
<td>Fundamentals of Speech</td>
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<tr>
<td><strong>Sp. 211</strong></td>
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<tr>
<td>Mechanical Metallurgy</td>
<td>4</td>
</tr>
<tr>
<td><strong>M.E. 331</strong></td>
<td></td>
</tr>
<tr>
<td>Mechanics of Materials II</td>
<td>3</td>
</tr>
<tr>
<td><strong>E.M. 346</strong></td>
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<tr>
<td>Rigid Body Dynamics</td>
<td>3</td>
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<tr>
<td><strong>E.M. 326</strong></td>
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<tr>
<td>Thermodynamics I</td>
<td>4</td>
</tr>
<tr>
<td><strong>M.E. 321</strong></td>
<td></td>
</tr>
<tr>
<td>Analysis for Engineering Economy</td>
<td>3</td>
</tr>
<tr>
<td><strong>I.E. 304</strong></td>
<td></td>
</tr>
<tr>
<td>Manufacturing Processes I</td>
<td>4</td>
</tr>
<tr>
<td><strong>M.E. 332</strong></td>
<td></td>
</tr>
<tr>
<td>Fluid Flow and Heat Transfer</td>
<td>3</td>
</tr>
<tr>
<td><strong>M.E. 424</strong></td>
<td></td>
</tr>
<tr>
<td>Thermodynamics II</td>
<td>3</td>
</tr>
<tr>
<td><strong>M.E. 322</strong></td>
<td></td>
</tr>
<tr>
<td>Introduction to Circuits</td>
<td>4</td>
</tr>
<tr>
<td>and Instruments</td>
<td></td>
</tr>
<tr>
<td><strong>E.E. 441</strong></td>
<td></td>
</tr>
<tr>
<td>Writing of Reports and Technical Papers</td>
<td>3</td>
</tr>
<tr>
<td><strong>Engl. 414</strong></td>
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<td>3</td>
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<tr>
<td><strong>M.E. 333</strong></td>
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<td>Machine Design I</td>
<td>4</td>
</tr>
<tr>
<td><strong>M.E. 420</strong></td>
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<tr>
<td>Thermodynamics III</td>
<td>3</td>
</tr>
<tr>
<td><strong>M.E. 323</strong></td>
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</tr>
<tr>
<td>Introduction to Circuits</td>
<td>4</td>
</tr>
<tr>
<td>and Instruments</td>
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<td><strong>E.E. 442</strong></td>
<td></td>
</tr>
<tr>
<td>Inspection Trip</td>
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</tr>
<tr>
<td><strong>M.E. 300</strong></td>
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</table>

**Total Credits:** 17

### Senior Year

<table>
<thead>
<tr>
<th>Course</th>
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<tbody>
<tr>
<td>Machine Design II</td>
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<tr>
<td><strong>M.E. 421</strong></td>
<td></td>
</tr>
<tr>
<td>Engineering Measurements I</td>
<td>3</td>
</tr>
<tr>
<td><strong>M.E. 461</strong></td>
<td></td>
</tr>
<tr>
<td>Fluid Flow and Heat Transfer</td>
<td>3</td>
</tr>
<tr>
<td><strong>M.E. 425</strong></td>
<td></td>
</tr>
<tr>
<td>Thermodynamics IV</td>
<td>4</td>
</tr>
<tr>
<td><strong>M.E. 324</strong></td>
<td></td>
</tr>
<tr>
<td>Socio-Humanistic Elective</td>
<td>3</td>
</tr>
<tr>
<td><strong>M.E. 400</strong></td>
<td></td>
</tr>
<tr>
<td>Machine Design III</td>
<td>3</td>
</tr>
<tr>
<td><strong>M.E. 422</strong></td>
<td></td>
</tr>
<tr>
<td>Engineering Measurements II</td>
<td>3</td>
</tr>
<tr>
<td><strong>M.E. 462</strong></td>
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</tr>
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<td>Technical Elective</td>
<td>8</td>
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<tr>
<td><strong>M.E. 425</strong></td>
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<td>3</td>
</tr>
<tr>
<td><strong>M.E. 324</strong></td>
<td></td>
</tr>
<tr>
<td>Mechanical Systems Design</td>
<td>4</td>
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<td><strong>M.E. 423</strong></td>
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<td><strong>M.E. 324</strong></td>
<td></td>
</tr>
</tbody>
</table>

**Total Credits:** 17

---

1Socio-humanistic electives are to be chosen from the department-approved sequences.

2May be omitted by students appointed to advanced ROTC.

3Technical electives are to be chosen from the department-approved groups.
Curriculum in Metallurgy

Leading to the degree Bachelor of Science. Total credits required—190, plus physical education.
See also Basic Program.

<table>
<thead>
<tr>
<th>FALL QUARTER</th>
<th>WINTER QUARTER</th>
<th>SPRING QUARTER</th>
</tr>
</thead>
<tbody>
<tr>
<td>Credits</td>
<td>Credits</td>
<td>Credits</td>
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**Sophomore Year**

<table>
<thead>
<tr>
<th>Course</th>
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<tbody>
<tr>
<td>Principles of Materials Science Met. 230</td>
<td>4</td>
</tr>
<tr>
<td>Analytic Geometry and Calculus III Math. 112</td>
<td>5</td>
</tr>
<tr>
<td>Introduction to Classical Physics Phys. 222</td>
<td>5</td>
</tr>
<tr>
<td>Socio-Humanistic Elective¹</td>
<td>3</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>17</strong></td>
</tr>
</tbody>
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<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extractive Metallurgy Met. 201</td>
<td>3</td>
</tr>
<tr>
<td>Elementary Differential Equations Math. 213</td>
<td>3</td>
</tr>
<tr>
<td>Introduction to Classical Physics Phys. 223</td>
<td>5</td>
</tr>
<tr>
<td>Statics of Engineering E.M. 274</td>
<td>3</td>
</tr>
<tr>
<td>Socio-Humanistic Elective¹</td>
<td>3</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>17</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Metal Processing Met. 203</td>
<td>3</td>
</tr>
<tr>
<td>Metallurgy Laboratory Met. 205</td>
<td>3</td>
</tr>
<tr>
<td>Mathematics, Statistics, or Computer Science Elective</td>
<td>3</td>
</tr>
<tr>
<td>Mechanics of Materials I E.M. 325</td>
<td>3</td>
</tr>
<tr>
<td>Socio-Humanistic Elective¹</td>
<td>3</td>
</tr>
<tr>
<td><strong>Total</strong></td>
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**Junior Year**

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
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<tbody>
<tr>
<td>Physical Metallurgy Met. 301</td>
<td>4</td>
</tr>
<tr>
<td>Physical Metallurgy Laboratory Met. 305</td>
<td>2</td>
</tr>
<tr>
<td>Metallurgy Seminar Met. 300</td>
<td>1</td>
</tr>
<tr>
<td>Physical Chemistry Chem. 321</td>
<td>3</td>
</tr>
<tr>
<td>American Government Pol.S. 215</td>
<td>3</td>
</tr>
<tr>
<td>Socio-Humanistic Elective¹</td>
<td>3</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>16</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical Metallurgy Met. 302</td>
<td>4</td>
</tr>
<tr>
<td>Physical Metallurgy Laboratory Met. 306</td>
<td>2</td>
</tr>
<tr>
<td>Metallurgy Seminar Met. 300</td>
<td>1</td>
</tr>
<tr>
<td>Metallurgical Thermochemistry Met. 360</td>
<td>3</td>
</tr>
<tr>
<td>Technical Elective²</td>
<td>3</td>
</tr>
<tr>
<td>Socio-Humanistic Elective¹</td>
<td>3</td>
</tr>
<tr>
<td><strong>Total</strong></td>
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</tbody>
</table>

**Senior Year**

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mechanical Behavior of Metals Met. 401</td>
<td>3</td>
</tr>
<tr>
<td>Modern Physics Phys. 301</td>
<td>3</td>
</tr>
<tr>
<td>Introduction to Circuits and Instruments E.E. 441</td>
<td>4</td>
</tr>
<tr>
<td>Technical Elective²</td>
<td>3</td>
</tr>
<tr>
<td>Socio-Humanistic Elective¹</td>
<td>3</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>16</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mechanical Behavior of Metals Met. 402</td>
<td>3</td>
</tr>
<tr>
<td>Modern Physics Phys. 302</td>
<td>3</td>
</tr>
<tr>
<td>Electronic Circuits, Instruments and Systems E.E. 445</td>
<td>4</td>
</tr>
<tr>
<td>Technical Elective²</td>
<td>3</td>
</tr>
<tr>
<td>Socio-Humanistic Elective¹</td>
<td>3</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>15</strong></td>
</tr>
</tbody>
</table>

¹These electives are to be selected with the approval of the adviser.
²Technical electives must include 3 credits in metallurgy and 3 credits in written or spoken English beyond Engl. 105.
The curricula of the College of Home Economics provide for the general or liberal education of the student as a person, a citizen, and family member, and for the education of the student for a variety of professional opportunities.

Qualified professional graduates are much in demand. They are needed in the field of education as teachers of young children, teachers of home economics in secondary schools and colleges, teachers of physical education for women, and extension home economists. In the food field, many opportunities exist for dietitians, food service directors, and school lunch supervisors. Food-processing equipment and textile companies employ home economists, as do retail clothing and home furnishing stores. Home economists are also placed in positions on the editorial staffs of magazines and newspapers, in the operation of recreation programs for children, and in social "helping" services. Research at universities, with commercial organizations, and with the federal government offers numerous opportunities.

**Faculty Adviser System**

Each student in the College of Home Economics has a faculty adviser. A selected group of faculty serves as advisers to freshmen; upperclass students are assigned faculty advisers in the departments of their chosen curricula.

All entering students and their parents are encouraged to participate in the summer orientation program. During the two-day program, the students take placement tests and confer with faculty advisers concerning the selection of courses for fall. Registration can be completed by mail before students come to the campus. See Index, Orientation.

**Curricula in Home Economics**

<table>
<thead>
<tr>
<th>CURRICULA</th>
<th>MAJORS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Applied Art</td>
<td>Advertising Design</td>
</tr>
<tr>
<td></td>
<td>Art Education</td>
</tr>
<tr>
<td></td>
<td>Craft Design</td>
</tr>
<tr>
<td></td>
<td>Interior Design</td>
</tr>
<tr>
<td>Child Development</td>
<td>Child Development</td>
</tr>
<tr>
<td>Family Environment</td>
<td>Family Environment</td>
</tr>
<tr>
<td>Food and Nutrition</td>
<td>Community Nutrition</td>
</tr>
<tr>
<td></td>
<td>Dietetics</td>
</tr>
<tr>
<td></td>
<td>Food Science</td>
</tr>
<tr>
<td></td>
<td>Food and Nutrition and Related Science</td>
</tr>
<tr>
<td></td>
<td>Home Economics Education</td>
</tr>
<tr>
<td></td>
<td>International Studies</td>
</tr>
<tr>
<td></td>
<td>Home Economics Journalism</td>
</tr>
<tr>
<td></td>
<td>College Food and Housing Administration</td>
</tr>
<tr>
<td></td>
<td>Hotel and Restaurant Management</td>
</tr>
<tr>
<td></td>
<td>School Food Service</td>
</tr>
<tr>
<td></td>
<td>Physical Education for Women</td>
</tr>
<tr>
<td></td>
<td>Textiles and Clothing</td>
</tr>
<tr>
<td></td>
<td>Textiles and Clothing and Related Science</td>
</tr>
</tbody>
</table>

---

**Footer:**

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**Curricula in Home Economics**

<table>
<thead>
<tr>
<th>CURRICULA</th>
<th>MAJORS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Applied Art</td>
<td>Advertising Design</td>
</tr>
<tr>
<td></td>
<td>Art Education</td>
</tr>
<tr>
<td></td>
<td>Craft Design</td>
</tr>
<tr>
<td></td>
<td>Interior Design</td>
</tr>
<tr>
<td>Child Development</td>
<td>Child Development</td>
</tr>
<tr>
<td>Family Environment</td>
<td>Family Environment</td>
</tr>
<tr>
<td>Food and Nutrition</td>
<td>Community Nutrition</td>
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<tr>
<td></td>
<td>Dietetics</td>
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<td></td>
<td>Food Science</td>
</tr>
<tr>
<td></td>
<td>Food and Nutrition and Related Science</td>
</tr>
<tr>
<td></td>
<td>Home Economics Education</td>
</tr>
<tr>
<td></td>
<td>International Studies</td>
</tr>
<tr>
<td></td>
<td>Home Economics Journalism</td>
</tr>
<tr>
<td></td>
<td>College Food and Housing Administration</td>
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<tr>
<td></td>
<td>Hotel and Restaurant Management</td>
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<tr>
<td></td>
<td>School Food Service</td>
</tr>
<tr>
<td></td>
<td>Physical Education for Women</td>
</tr>
<tr>
<td></td>
<td>Textiles and Clothing</td>
</tr>
<tr>
<td></td>
<td>Textiles and Clothing and Related Science</td>
</tr>
</tbody>
</table>
Cooperative Program

The College of Home Economics has cooperative programs with Morningside and Central colleges. A student may take two years at either of these liberal arts colleges and two years at Iowa State University without the usual formalities of transferring.

A special grouping of courses is provided which makes it possible for a student to pursue any of the curricula offered by the College of Home Economics.

Applications for admission to the cooperative program in home economics should be addressed to the director of admissions of the appropriate liberal arts college.

The Core Curriculum

The educational foundation of students in the College of Home Economics is provided through the election of selected courses within specified areas identified as the core curriculum. Election of courses of a general nature provides breadth of education.

All students in the College of Home Economics must complete the specified credits in the core curriculum, except those who choose a major in related science combined with food and nutrition or textiles and clothing, and those who choose the curriculum in physical education for women.

Core requirements are in subject areas both within and outside the College of Home Economics. (See listing below.) Whereas the number of credits required for each group is universal for all majors in the College (unless specified), the possible choices for meeting the requirements are specified by departments and are incorporated in the listings of curricula by departments, which appear on the following pages.

Subject areas within the College of Home Economics:

<table>
<thead>
<tr>
<th>Subject areas</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Applied Art, Textiles and Clothing</td>
<td>3</td>
</tr>
<tr>
<td>Equipment and Housing</td>
<td>3</td>
</tr>
<tr>
<td>Family and the Child</td>
<td>3</td>
</tr>
<tr>
<td>Management</td>
<td>3</td>
</tr>
<tr>
<td>Nutrition</td>
<td>3</td>
</tr>
<tr>
<td>Professional Relations, H.Ec. 400</td>
<td>R</td>
</tr>
<tr>
<td>Physical Education</td>
<td>3</td>
</tr>
</tbody>
</table>

Subject areas outside the College of Home Economics:

<table>
<thead>
<tr>
<th>Subject areas</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biological Sciences</td>
<td>8</td>
</tr>
<tr>
<td>Physical Sciences, Mathematics, Statistics</td>
<td>8</td>
</tr>
<tr>
<td>Social Sciences</td>
<td>15</td>
</tr>
<tr>
<td>Humanities</td>
<td>15</td>
</tr>
<tr>
<td>Library, Lib. 160</td>
<td></td>
</tr>
<tr>
<td>Written and Spoken English</td>
<td>11</td>
</tr>
</tbody>
</table>

All students are required to complete 3 credits of physical education. See Physical Education for Women for details. A student is expected to enroll in physical education during the first quarter registered and to continue in each subsequent quarter until requirement is completed.

Library instruction is to be completed within the first year of registration.

Students may prepare for work in the extension service by enrolling in any of the home economics curricula. The following courses should be included: Psych. 333, Educ. 305, 468. In addition, the following suggested courses should be considered in consultation with the state leader of home economics extension programs, one of the district leaders for home economics programs or the coordinator of extension personnel training: Ag.Ed. 211B; A.A. 261; C.D. 236, 336, 337; F.E. 240, 254, 285, 385, 415, 488, 521, 522, 575; F.& N. 208, 232, 303; I.Mgt. 380; Soc. 364, 464; Sp. 312; J.L. 225.

Students in the curricula of child development and of family environment may prepare for the social “helping” services such as family and consumer services with public and private
agencies. The choice of courses from such fields as anthropology, child development, family environment, food and nutrition, psychology, and sociology will be jointly determined by the student and his adviser in relation to the student's educational objectives. (See Child Development curriculum, Family Environment curriculum.)

Students interested in nutrition with health and welfare agencies may prepare for employment through the major in community nutrition. The home economists employed by these agencies would be applying their specialized knowledge in programs designed to establish or maintain the health and well-being of families and individuals. This might be through consultation with welfare staff or through serving the family directly, depending upon the agency program.

Preparation for work as a home economist in the field of television or radio may be combined with such curricula as applied art, child development, food science, and textiles and clothing. The student wishing to combine preparation for work in broadcasting with one of these curricula should consult with the director of the telecommunicative arts program.

Home Economics and Related Science

Related science programs are available in the departments of Child Development, Family Environment, Food and Nutrition, and Textiles and Clothing. These programs provide a background for graduate study basic to professional advancement in the specified fields. Students who have completed one of these majors have found opportunities in research and teaching in colleges and universities, medical laboratories, foundations, and industry.

Curriculum in Applied Art

Leading to the degree Bachelor of Science. Total credits required—195.

Majors are offered in advertising design, art education, craft design, and interior design.

Core Curriculum Requirements

<table>
<thead>
<tr>
<th>Core Curriculum Requirements</th>
<th></th>
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</thead>
<tbody>
<tr>
<td>Home Economics Core</td>
<td>16 credits</td>
</tr>
<tr>
<td>Applied Art, Textiles and Clothing</td>
<td>4 credits</td>
</tr>
<tr>
<td>Design, A.A. 103</td>
<td></td>
</tr>
<tr>
<td>Equipment and Housing</td>
<td>3 credits</td>
</tr>
<tr>
<td>Select from F.E. 240, 254, 308, 318, 412</td>
<td></td>
</tr>
<tr>
<td>Family and the Child</td>
<td>3 credits</td>
</tr>
<tr>
<td>Select from C.D. 236, 337; F.E. 185, 285</td>
<td></td>
</tr>
<tr>
<td>Management</td>
<td>3 credits</td>
</tr>
<tr>
<td>Select from F.E. 341, 488</td>
<td></td>
</tr>
<tr>
<td>Nutrition</td>
<td>3 credits</td>
</tr>
<tr>
<td>Select from F.&amp; N. 107, 232</td>
<td></td>
</tr>
<tr>
<td>Professional Relations, H.Ec. 400</td>
<td>R</td>
</tr>
<tr>
<td>Applied Art Core</td>
<td>34 credits</td>
</tr>
<tr>
<td>Perspective Drawing, A.A 100</td>
<td>2 credits</td>
</tr>
<tr>
<td>Design, A.A. 104</td>
<td>3 credits</td>
</tr>
<tr>
<td>Drawing, A.A. 150</td>
<td>3 credits</td>
</tr>
<tr>
<td>Lettering, A.A. 170</td>
<td>3 credits</td>
</tr>
<tr>
<td>Color, A.A. 203</td>
<td>3 credits</td>
</tr>
<tr>
<td>Watercolor, A.A. 233</td>
<td>3 credits</td>
</tr>
<tr>
<td>Intermediate Drawing, A.A 250</td>
<td>3 credits</td>
</tr>
<tr>
<td>Study Tour, A.A. 300</td>
<td>R</td>
</tr>
<tr>
<td>History of Art, A.A. 301, 302, 303</td>
<td>9 credits</td>
</tr>
<tr>
<td>Colloquium, A.A. 310</td>
<td>1 credit</td>
</tr>
<tr>
<td>Textile Design, A.A. 347</td>
<td>4 credits</td>
</tr>
</tbody>
</table>
Major in Advertising Design

This major prepares students for positions in graphic design. Such work requires imagination and skill in the layout and design of visual media that will express concept and purpose with clarity and style.

In addition to the core curriculum requirements, the following courses are to be completed:

- **Applied Art**: 24 credits
  - Lettering for Graphics, A.A. 270
  - Typography, A.A. 272
  - Oil Painting, A.A. 333
  - Life Drawing, A.A. 350
  - Advertising Design, A.A. 370, 371
  - Graphic Art Production, A.A. 373
  - Illustration for Advertising, A.A. 474

- **Journalism and Mass Communication**: 13 credits
  - Publicity and Public Relations, Jl. 225
  - Fundamentals of Photography, Jl. 317
  - Advertising, Jl. 325
  - Layout and Design of Publications, Jl. 342

Electives: 30-47 credits

Students who elect an emphasis in fashion illustration should declare this intention by the first quarter of the junior year and must take the following:

- Fashion Illustration, A.A. 278, 279: 6 credits
- Special Problems, A.A. 490G: 2-3 credits
- Textiles, T.&C. 104: 4 credits
- History of Costume, T.&C. 454: 3 credits

Major in Art Education

This major is planned for students preparing for certification to teach art at the secondary level only or in grades kindergarten through twelve. Students may enroll in art education but, to be admitted, must apply and be accepted by a department committee and the Committee on Academic Standards of the College of Education. For general requirements for teacher certification, see College of Education.

In addition to the core curriculum requirements, the following courses are to be completed by students preparing to teach at the secondary level:
### Applied Art

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weaving, A.A. 244</td>
<td>3</td>
</tr>
<tr>
<td>Design in Metal and Enamel, A.A. 247</td>
<td>3</td>
</tr>
<tr>
<td>Fundamentals of Interior Design, A.A. 261</td>
<td>3</td>
</tr>
<tr>
<td>Oil Painting, A.A. 333</td>
<td>3</td>
</tr>
<tr>
<td>Ceramics, A.A. 340</td>
<td>3</td>
</tr>
<tr>
<td>Design in Wood, A.A. 345</td>
<td>3</td>
</tr>
<tr>
<td>Life Drawing, A.A. 350</td>
<td>3</td>
</tr>
<tr>
<td>Advertising Design, A.A. 370</td>
<td>3</td>
</tr>
<tr>
<td>Jewelry, A.A. 446</td>
<td>3</td>
</tr>
</tbody>
</table>

### Professional Education

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Foundations of American Education, Educ. 204</td>
<td>3</td>
</tr>
<tr>
<td>Methods of Teaching, Educ. 305A, 305B</td>
<td>4</td>
</tr>
<tr>
<td>Principles of Secondary Education, Educ. 426</td>
<td>3</td>
</tr>
<tr>
<td>Developmental Psychology, Psych. 230 1</td>
<td>3</td>
</tr>
<tr>
<td>Educational Psychology, Psych. 333 1</td>
<td>3</td>
</tr>
<tr>
<td>Art Methods for the Secondary School, A.A. 415</td>
<td>3</td>
</tr>
<tr>
<td>Supervised Teaching of Art in the Secondary School, A.A. 417</td>
<td>8-9</td>
</tr>
</tbody>
</table>

### Electives

Students who elect the K-12 program will complete the following courses in addition to the core curriculum requirements:

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weaving, A.A. 244</td>
<td>3</td>
</tr>
<tr>
<td>Design in Metal and Enamel, A.A. 247</td>
<td>3</td>
</tr>
<tr>
<td>Fundamentals of Interior Design, A.A. 261</td>
<td>3</td>
</tr>
<tr>
<td>Oil Painting, A.A. 333</td>
<td>3</td>
</tr>
<tr>
<td>Ceramics, A.A. 340</td>
<td>3</td>
</tr>
<tr>
<td>Design in Wood, A.A. 345</td>
<td>3</td>
</tr>
<tr>
<td>Advertising Design, A.A. 370</td>
<td>3</td>
</tr>
<tr>
<td>Supervised Teaching of Art in the Secondary School, A.A. 417</td>
<td>8-9</td>
</tr>
</tbody>
</table>

### Professional Education

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Foundations of American Education, Educ. 204</td>
<td>3</td>
</tr>
<tr>
<td>Methods of Teaching, Educ. 305A, 305B</td>
<td>4</td>
</tr>
<tr>
<td>Principles of Secondary Education, Educ. 426</td>
<td>3</td>
</tr>
<tr>
<td>Developmental Psychology, Psych. 230 1</td>
<td>3</td>
</tr>
<tr>
<td>Educational Psychology, Psych. 333 1</td>
<td>3</td>
</tr>
<tr>
<td>Art Methods for the Elementary School, A.A. 415</td>
<td>3</td>
</tr>
<tr>
<td>Art Methods for the Secondary School, A.A. 416</td>
<td>3</td>
</tr>
<tr>
<td>Supervised Teaching of Art in the Secondary School, A.A. 417</td>
<td>8-9</td>
</tr>
<tr>
<td>Principles of Teaching in the Elementary School, El.Ed. 344</td>
<td>2</td>
</tr>
</tbody>
</table>

### Major in Craft Design

This major provides a broad background in crafts with a strong emphasis in two craft media. The student is prepared to operate a shop or market crafts, to engage in freelance design, to work in an organizational capacity in community or welfare workshops, or to become a teacher in public or private adult education.

In addition to the core curriculum requirements, the following courses are to be completed:

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weaving, A.A. 244</td>
<td>3</td>
</tr>
<tr>
<td>Design in Metal and Enamel, A.A. 247</td>
<td>3</td>
</tr>
<tr>
<td>Oil Painting, A.A. 333</td>
<td>3</td>
</tr>
<tr>
<td>Ceramics, A.A. 340</td>
<td>3</td>
</tr>
<tr>
<td>Design in Wood, A.A. 345</td>
<td>3</td>
</tr>
<tr>
<td>Jewelry, A.A. 446</td>
<td>3</td>
</tr>
</tbody>
</table>
The craft design major must take a concentration of 18 credits in two areas (9 each) from the following six craft areas:

- Textile Design, A.A. 348 and 490B
- Weaving, A.A. 245 and 490C
- Ceramics, A.A. 490D
- Jewelry, A.A. 490J
- Design in Wood, A.A. 490K
- Design in Metal and Enamel, A.A. 490L

Students who elect an emphasis in textile design or weaving must take the following:

- Textiles and Clothing.............. 7 credits
- Textiles, T.&C 104......................... 4 credits
- Historic Textiles, T.&C 414.............. 3 credits

Electives..................................... 41-48 credits

Major in Interior Design

This major is planned for art students who enter the professional field of interior design and decoration.

In addition to the core curriculum requirements, the following courses are to be completed:

Applied Art............................................. 38 credits
- Fundamentals of Interior Design, A.A. 261
- Interior Sketching, A.A. 264
- Textile Design, A.A. 348
- History of Furniture, A.A. 361, 362
- Interior Design, A.A. 364, 365
- Apprenticeship, A.A. 466
- Commercial Interior Design, A.A. 467
- Professional Interior Design Procedures, A.A. 468
- Special Problems, A.A. 490E

Architecture.................................. 6 credits
- Residential Architecture I, Arch. 361
- Special Problems in Architecture, Arch. 490

Textiles and Clothing.................................. 7 credits
- Textiles, T.&C 104
- Historic Textiles, T.&C 414

Electives............................................. 33 credits

Curriculum in Child Development

Leading to degree of Bachelor of Science. Total credits required—195.

The student majoring in child development may select one of three options: (1) nursery school-kindergarten education, (2) community services for children, or (3) pregraduate study.

Core Curriculum Requirements

Home Economics Core............................................. 15 credits
- Applied Art, Textiles and Clothing
- Equipment and Housing
- Family and the Child
- Management
- Nutrition
- Professional Relations, H.Ec. 400

Applied, Textiles and Clothing
- Select from A.A. 103, 150, 200, 384; T.&C 104, 121

Equipment and Housing
- Select from F.E. 240, 254, 318

Family and the Child
- Select from F.E. 285, 385

Management
- Select from F.E. 375, 415, 488; I.Mgt. 287

Nutrition
- Select from F.&N. 107, 232

Professional Relations, H.Ec. 400
Nursery School/Kindergarten Education Option

In addition to the core curriculum requirements, the following courses are to be completed:

Home Economics .................................................. 22 credits

Planning Curricula for the Young Child, C.D. 461.......................... 2 credits
Supervised Teaching in Nursery School/Kindergarten, C.D. 467A 1 ........................................................................ 7 credits
Home-School Relations in Supervised Teaching, C.D. 467B 1 ......................................................................................... 2 credits
Supervised Teaching in Child Centers, C.D. 467E, 467F 1 ......................................................................................... 8 credits
Administration of Programs for Young Children, C.D. 468.......................... 3 credits

Biological Sciences .................................................. 4 credits

Human Prenatal Development, Zool. 358 ............................................. 4 credits

Mathematics ........................................................................... 3 credits

Social Sciences ........................................................................... 18 credits

Developmental Psychology, Psych. 230............................................. 3 credits
Educational Psychology, Psych. 333 ................................................... 3 credits
Select from Psychology .................................................................. 6 credits
Select from Sociology (Omit Soc. 2191) ............................................. 3 credits
American Government, Pol.S. 215 ................................................... 3 credits

Communicative Arts .................................................................... 3 credits

Select from English, technical journalism, or speech and telecommunicative arts

Education ................................................................................. 6 credits

Foundations of American Education, Educ. 204 .......................... 3 credits
Methods of Teaching, Educ. 305B .................................................... 1 credit
Principles of Teaching in the Elementary School, El.Ed 344A 2 ........................................................................ 2 credits

Music ......................................................................................... 3 credits

Music in Early Childhood Education, Music 364

Electives ...................................................................................... 31 credits

1To be taken concurrently

2Application for admission to the teacher education program of the University is routinely included as a part of El.Ed. 344A
Community Services for Children Option

In addition to the core curriculum requirements, the following courses are to be completed:

Home Economics.................................................................21 credits
  Planning Curricula for the Young Child, C.D 461 ....................2 credits
  Administration of Programs for Young Children, C.D 468 .......3 credits
  Participation in Group Activities for Children, C.D 470A 1 .........6 credits
  Adult-Child Relations, C.D. 470B 1 ...........................................2 credits
  Group Work with Children, C.D 470E, 470F 1 .........................8 credits

Mathematics ...........................................................................3 credits

Social Sciences ........................................................................31 credits
  Kinship in Different Cultures, Anthro. 421 ..............................3 credits
  Culture and Personality, Anthro. 422 ......................................3 credits
  Developmental Psychology, Psych. 230 .................................3 credits
  Psychology of Exceptional Children, Psych. 436 .....................3 credits
  Psychology of Adjustment, Psych. 460 ....................................4 credits
  Race and Minority Group Relations, Soc. 300 .........................3 credits
  Social Stratification, Soc. 330 .................................................3 credits
  Sociology of Deviance, Soc. 341 .............................................3 credits
  Urban Sociology, Soc. 410 ......................................................3 credits
  Human Ecology, Soc. 450 ........................................................3 credits

Electives ..................................................................................35 credits

1To be taken concurrently

Pregraduate Study Option

In addition to the core curriculum requirements, the following courses are to be completed:

Home Economics....................................................................3 credits
  Introduction to Child Development Research, C.D 464

Physical Sciences, Biological Sciences, Mathematics ..................31 credits
  General Chemistry, Chem. 142, 142L .....................................4 credits
  Elementary Organic Chemistry, Chem. 231, 232 ..................5 credits
  Survey of Biochemistry, B. & B. 301 .................................3 credits
  Finite Mathematics, Math. 104 .............................................5 credits
  Introduction to Mathematical Ideas, Math. 105 .................4 credits
  Principles of Physiology, Zool. 455 .................................4 credits
  Select from physics, chemistry, genetics, food and nutrition, zoology 6 credits

Social Sciences .........................................................................27 credits
  Culture and Personality, Anthro. 422 ....................................3 credits
  Learning and Motivation, Psych. 206 ....................................3 credits
  Sensation and Perception, Psych. 202 .................................3 credits
  Research Design and Methodology, Psych. 301 .................3 credits
  Experimental Psychology Laboratory, Psych. 302 ............3 credits
  Psychological Measurement I, Psych. 440 ........................3 credits
  Psychological Scaling, Psych. 441 .....................................3 credits
  Sociological Inquiry, Soc. 202 ............................................3 credits
  Social Interaction, Soc. 305 ...............................................3 credits

Written and Spoken English ..................................................3 credits
  Writing of Reports and Technical Papers, Engi. 414

Foreign Language ....................................................................8 credits

Electives ...............................................................................18 credits
Curriculum in Family Environment

Leading to the degree Bachelor of Science. Total credits required—195.

This curriculum is designed for the student desiring a broadly based education within home economics which has an integrated and interdisciplinary focus on the family as and in its environment. Students may choose their courses to emphasize one of the following: helping services; consumer services in areas of housing, equipment, management, and family; community services; or general education. The subject matter areas within family environment include courses in consumer behavior, family, household equipment, housing, and management.

All students in family environment will have coursework which emphasizes the family, its near environment, and the interaction of the family with its environment. A portion of the total coursework will be related to the emphasis chosen. Students will also choose at least 12 credits from one subject matter area within family environment. An additional 12 credits will be selected in courses appropriate to the student's major interest.

<table>
<thead>
<tr>
<th>Home Economics Core</th>
<th>15-17 credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Art, Textiles and Clothing</td>
<td>3-4 credits</td>
</tr>
<tr>
<td>Select from applied art or textiles and clothing</td>
<td></td>
</tr>
<tr>
<td>Equipment and Housing</td>
<td>3 credits</td>
</tr>
<tr>
<td>Select from F.E. 254, 308, 318, 340, 341, 408A, 412, 445, 446</td>
<td></td>
</tr>
<tr>
<td>Family and Child</td>
<td>3 credits</td>
</tr>
<tr>
<td>Select from C.D. 236, F.E. 270, 285, 385</td>
<td></td>
</tr>
<tr>
<td>Management</td>
<td>3 credits</td>
</tr>
<tr>
<td>Select from F.E. 375, 415, 488</td>
<td></td>
</tr>
<tr>
<td>Nutrition</td>
<td>3-4 credits</td>
</tr>
<tr>
<td>Select from F.&amp;N. 107, 232</td>
<td></td>
</tr>
<tr>
<td>Professional Relations, H.Ec. 400</td>
<td>R</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Family Environment Core</th>
<th>15 credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Families and Their Environment, F.E. 185</td>
<td>3 credits</td>
</tr>
<tr>
<td>Introduction to Family Housing, F.E. 240</td>
<td>3 credits</td>
</tr>
<tr>
<td>Equipment and Housing</td>
<td>3 credits</td>
</tr>
<tr>
<td>Select from F.E. 254, 308, 318, 340, 341, 408A, 412, 445, 446</td>
<td></td>
</tr>
<tr>
<td>Family and Child</td>
<td>3 credits</td>
</tr>
<tr>
<td>Select from C.D. 236, F.E. 270, 285, 385</td>
<td></td>
</tr>
<tr>
<td>Management</td>
<td>3 credits</td>
</tr>
<tr>
<td>Select from F.E. 375, 415, 488</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Family Environment Concentration</th>
<th>45 credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biological Sciences</td>
<td>8 credits</td>
</tr>
<tr>
<td>Elementary Human Physiology and Anatomy, Zool. 155</td>
<td>5 credits</td>
</tr>
<tr>
<td>Select from biology, bacteriology, botany, zoology, genetics</td>
<td>3 credits</td>
</tr>
<tr>
<td>Physical Sciences, Statistics, Mathematics</td>
<td>8-9 credits</td>
</tr>
<tr>
<td>Select from chemistry, geology, mathematics, meteorology, physics, statistics</td>
<td></td>
</tr>
<tr>
<td>Social Sciences</td>
<td>15 credits</td>
</tr>
<tr>
<td>Principles of Economics, Econ. 241 or 242</td>
<td>3 credits</td>
</tr>
<tr>
<td>Introduction to Sociology, Soc. 134</td>
<td>3 credits</td>
</tr>
<tr>
<td>Select from psychology</td>
<td>3 credits</td>
</tr>
<tr>
<td>Select from anthropology, economics, political science, psychology, sociology</td>
<td>6 credits</td>
</tr>
<tr>
<td>Humanities</td>
<td>15 credits</td>
</tr>
<tr>
<td>Select from foreign language, history, literature, music, philosophy</td>
<td></td>
</tr>
<tr>
<td>Written and Spoken English</td>
<td>11 credits</td>
</tr>
<tr>
<td>Language in Composition and Reading, Engl. 104, 105</td>
<td>8 credits</td>
</tr>
<tr>
<td>Select from Sp. 211, 207</td>
<td>3 credits</td>
</tr>
<tr>
<td>Library Instruction, Lib. 160</td>
<td>1 credit</td>
</tr>
<tr>
<td>Physical Education</td>
<td>3 credits</td>
</tr>
<tr>
<td>Electives</td>
<td>56-59 credits</td>
</tr>
</tbody>
</table>
Curriculum in Food and Nutrition

Leading to the degree Bachelor of Science. Total credits required—195.

The department offers four majors: community nutrition, dietetics, food science, and food and nutrition and related science.

Each of the programs provides for competencies in food and nutrition needed by volunteer workers for foreign programs. Electives may be applied toward meeting the requirements for certification for teaching.

All majors except food and nutrition and related science have the following courses in common. Students with special areas of interest, such as chemistry, may, in consultation with an adviser, use elective credit to substitute longer sequences of courses for those listed.

Core Curriculum Requirements

Home Economics Core........................................................................................................................................................................ 18-20 credits

Applied Art, Textiles and Clothing................................................................. 4 credits

Design, A A 103

Equipment and Housing ............................................................................. 3 credits

Select from A A 285, F E 240, 254, I Mgt. 485

Family and the Child...................................................................................... 3 credits

Select from C D 236, F E 270, 285

Management.................................................................................................... 4 credits

Quantity Food Production Management, I Mgt. 380

Nutrition........................................................................................................ 4 credits

Nutrition and the Family's Food, F & N 107

Professional Relations, H Ec 400

Food and Nutrition Core................................................................................ 18 credits

Foods I, II, F & N 214, 215.............................................................................. 8 credits

Family Meal Management, F & N 303........................................................................ 4 credits

Nutrition and Dietetics, F & N 305........................................................................ 4 credits

Seminar in Food and Nutrition, F & N 404.................................................... 2 credits

Biological Sciences.......................................................................................... 15 credits

Introductory Bacteriology, Bact. 300............................................................ 5 credits

Principles of Biology, Biol. 101........................................................................ 3 credits

Experimental Biology, Biol. 101A.................................................................... 2 credits

Elementary Human Physiology and Anatomy, Zool. 155............................. 5 credits

Physical Sciences........................................................................................... 22 credits

General Chemistry, Chem. 141, 142.................................................................. 6 credits

Laboratory in General Chemistry, Chem. 141L, 142L.................................... 2 credits

Elementary Organic Chemistry, Chem. 231.................................................. 3 credits

Laboratory in Elementary Organic Chemistry, Chem. 232B.......................... 2 credits

Survey of Biochemistry, B & B 301................................................................. 3 credits

Laboratory in Biochemistry, B & B 311........................................................ 2 credits

Elementary Physics, Phys. 106....................................................................... 4 credits

Social Sciences............................................................................................... 15 credits

Principles of Economics, Econ. 241, 242......................................................... 6 credits

American Government, Pol. S. 215............................................................... 3 credits

General Psychology, Psych. 101..................................................................... 3 credits

Introduction to Sociology, Soc. 134................................................................... 3 credits

Humanities..................................................................................................... 15 credits

History.......................................................................................................... 6 credits

Select from philosophy, literature, foreign language, music, history.............. 9 credits

Written and Spoken English......................................................................... 11 credits

Language in Composition and Reading, Engl. 104, 105.................................... 8 credits

Fundamentals of Speech, Sp. 211.................................................................... 3 credits

Library Instruction, Lib. 160........................................................................... 1 credit

Physical Education......................................................................................... 3 credits

4. Mgt. 485 will satisfy a requirement in dietetics major
Major in Community Nutrition

This major provides basic preparation for students who desire employment with nutrition services of social welfare agencies, public health departments, commercial organizations, or extension.

In addition to the core curriculum requirements, the following courses are to be completed:

- Home Economics...
- Family Finance, F.E. 488 ........................................................................................................ 3 credits
- Field Study Tour, F.&N. 400A ........................................................................................................ R
- Diet Therapy, F.&N. 409 ........................................................................................................ 4 credits
- Nutrition During Human Growth and Development, F.&N. 410 ........................................... 3 credits
- Experimental Studies of Foods, F.&N. 411 ........................................................................ 4 credits
- Community Nutrition, F.&N. 413 ......................................................................................... 3 credits
- Seminar in Community Nutrition, F.&N. 414 ........................................................................ 2 credits
- Biological Sciences.................................................................................................................. 3-4 credits
  - Human Heredity, Gen. 400 (3 cr.)
  - or
  - Human Physiology, Zool. 256 (4 cr.)
- Mathematics and Statistics ...................................................................................................... 8 credits
  - Mathematics .......................................................................................................................... 3 credits
  - Principles of Statistics, Stat. 101 ........................................................................................ 5 credits
- Social Sciences.......................................................................................................................... 9 credits
  - Developmental Psychology, Psych. 230 ................................................................................ 3 credits
  - Educational Psychology, Psych. 333 .................................................................................... 3 credits
  - Group Dynamics, Soc. 364 .................................................................................................. 3 credits
- Publicity and Public Relations, Jl. 225 .................................................................................... 3 credits
- Electives...................................................................................................................................... 34-37 credits

Major in Dietetics

This major serves the interests of the student who wishes to be prepared to work in nutrition education, including the medical aspects of nutrition, and in food service. The program gives preparation for hospital and other dietetic internship programs and includes courses necessary to meet the academic requirements of the American Dietetic Association.

In addition to the core curriculum requirements, the following courses are to be completed:

- Home Economics..................................................................................................................... 24 credits
- Field Study Tour, F.&N. 400A ................................................................................................ R
- Diet Therapy, F.&N. 409 ........................................................................................................ 4 credits
- Nutrition During Human Growth and Development, F.&N. 410 ........................................... 3 credits
- Experimental Studies of Foods, F.&N. 411 ........................................................................ 4 credits
- Methods of Teaching Nutrition, F.&N. 418 ........................................................................ 3 credits
- Purchasing and Inventory Management, I.Mgt. 484 ................................................................. 4 credits
- Organization and Management, I.Mgt. 487 .......................................................................... 3 credits
- Personnel Management in Institutions, I.Mgt. 488 ................................................................ 3 credits
- Biological Sciences.................................................................................................................. 3-4 credits
  - Human Heredity, Gen. 400 (3 cr.)
  - or
  - Human Physiology, Zool. 256 (4 cr.)
- Social Sciences......................................................................................................................... 6 credits
  - Developmental Psychology, Psych. 230 ................................................................................ 3 credits
  - Educational Psychology, Psych. 333 .................................................................................... 3 credits
  - Select any course in written English
  - or
  - Publicity and Public Relations, Jl. 225 (3 cr.) ..................................................................... 3 credits
- Select from I.Ad. 384, I.Mgt. 485, Stat. 101 ........................................................................ 3-4 credits
- Electives..................................................................................................................................... 34-41 credits

4. I.Mgt. 484 will satisfy a requirement in home economics core
Major in Food Science

This major serves those who are interested in developing food products for the market in food promotion programs in industries, in experimental food kitchens, in food research laboratories, in writing food columns for papers and magazines, and in directing food programs on radio and television. This program also leads to careers in consumer services in business and industry. For emphasis in food marketing and advertising, it is recommended that additional courses be selected from economics, psychology, and statistics.

In addition to the core curriculum requirements, the following courses are to be completed:

Home Economics .......................................................................................................................... 23 credits
- Family Finance, F.E. 488........................................................................................................ 3 credits
- Fundamentals of Food Measurements, F.&N. 320................................................................. 3 credits
- Field Study Tour, F.&N. 400B .................................................................................................. R
- Nutrition During Human Growth and Development, F &N 410 (3 cr.)
  - or
  - Community Nutrition, F.&N 413 (3 cr.) .......................................................................... 3 credits
  - History of Food, F.&N. 420 ............................................................................................... 3 credits
  - Principles of Food Science I, II, F.&N. 421, 422................................................................. 8 credits
  - Introduction to Research in Food Science, F.&N. 423...................................................... 3 credits

Written and Spoken English ................................................................................................. 9 credits
- Speech Elective ....................................................................................................................... 3 credits
- Publicity and Public Relations, JI. 225 .................................................................................. 3 credits
- Advertising, JI. 325 (3 cr.) .................................................................................................... 3 credits
  - or
  - Writing of Reports and Technical Papers, Engl. 414 (3 cr.) .............................................. 3 credits
  - Select from physical and biological sciences, economics, mathematics, and statistics .................................................................................................................................................................................................................................................. 5 credits
  - Electives............................................................................................................................. 38-40 credits

Major in Food and Nutrition and Related Science

This major is planned for students who are especially interested in emphasizing physical and biological sciences in relation to food and nutrition. Graduates have positions in research laboratories in colleges and universities, medical laboratories, foundations, and industry. They also have a background for graduate study, which is basic to teaching in colleges and universities and for professional advancement in the areas of food and nutrition.

Home Economics ..................................................................................................................... 39-41 credits
- Design, A.A. 103 (4 cr.) ....................................................................................................... 3-4 credits
  - or
  - Survey of Art, A.A. 384 (3 cr.) .......................................................................................... 3-4 credits
- Foods I, II, F.&N. 214, 215 .................................................................................................... 8 credits
- Family Meal Management, F.&N. 303 .................................................................................. 4 credits
- Nutrition and Dietetics, F.&N. 305 ....................................................................................... 4 credits
- Seminar in Food and Nutrition, F.&N. 404 .......................................................................... 2 credits
- Experimental Studies of Food, F.&N. 411 ............................................................................. 4 credits
- Introduction to Nutrition Research, F.&N. 415 ................................................................... 3 credits
- Select from F.&N. 409, 410, 413 ......................................................................................... 3-4 credits
- Professional Relations, H.Ec. 400 ...................................................................................... R
  - Select from courses in home economics other than those in major area ................................ 6 credits

Biological Sciences .................................................................................................................. 19 credits
- General Bacteriology, Bact. 300 .......................................................................................... 5 credits
- Principles of Biology, Biol. 101 ............................................................................................ 3 credits
- Experimental Biology, Biol. 101A ......................................................................................... 2 credits
- General Zoology, Zool. 106 ................................................................................................... 5 credits
- Principles of Physiology, Zool. 455 ...................................................................................... 4 credits

Physical Sciences ................................................................................................................... 56-57 credits
- General Chemistry, Chem. 141, 142 ................................................................................... 6 credits
- Laboratory in General Chemistry, Chem. 141L, 142L ......................................................... 2 credits
- Quantitative Analysis, Chem. 211 ...................................................................................... 2 credits
- Organic Chemistry, Chem. 334, 335, 336 .......................................................................... 9 credits
- Laboratory in Organic Chemistry, Chem. 337 ..................................................................... 2 credits
Physiological Chemistry, B.&B. 304, 305 6 credits
or Principles of Biochemistry, B.&B. 404, 405 6 credits
Precalculus Mathematics, Math. 109 5 credits
Analytic Geometry and Calculus I and II, Math. 110, 111 10 credits
General Physics, Phys. 111, 112 8 credits
Select from physical sciences, mathematics, statistics 3-4 credits

Precalculus Mathematics, Math. 109 5 credits

Social Sciences and Humanities 23 credits
F.L. 101 and 102 or 121 and 122 or 131 and 132 8 credits
History 6 credits
American Government, Pol.S. 215 3 credits
Additional (other than foreign languages) 6 credits

Written and Spoken English 11 credits
Language in Composition and Reading, Engl. 104, 105 8 credits
Fundamentals of Speech, Sp. 211 3 credits

Library Instruction, Lib. 160 1 credit
Physical Education 3 credits
Electives 40-43 credits
Curriculum in Home Economics

Leading to the degree Bachelor of Science. Total credits required—195.

Major in International Studies

Students in this curriculum may develop a program with emphasis in international service. This is designed to provide students with a background for participation in government or agency programs, as well as provide an opportunity to become oriented to national and international affairs as part of the responsibility of citizenship in its broadest sense. For further information, see Index: International Studies.

The curriculum requirements are:

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Home Economics Core</strong></td>
<td>16-17</td>
</tr>
<tr>
<td>Applied Art, Textiles and Clothing</td>
<td>3-4</td>
</tr>
<tr>
<td>Equipment and Housing, F.E. 240</td>
<td>3</td>
</tr>
<tr>
<td>Family and the Child</td>
<td>3</td>
</tr>
<tr>
<td>Principles of Child Development, C.D. 236</td>
<td></td>
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<tr>
<td>Management</td>
<td>3</td>
</tr>
<tr>
<td>Select from F.E. 375 or Mgt 287</td>
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<tr>
<td>Nutrition</td>
<td>4</td>
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<tr>
<td>Nutrition and the Family's Food, F &amp; N 107</td>
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<tr>
<td><strong>Home Economics</strong></td>
<td>36</td>
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<tr>
<td>Family Needs and Services in American Culture, F.E. 285</td>
<td>3</td>
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<tr>
<td>Family Finance, F.E. 488</td>
<td>3</td>
</tr>
<tr>
<td>Principles of Food Preparation, F &amp; N 208</td>
<td>5</td>
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<tr>
<td>Professional Relations, H.Ec. 400</td>
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<tr>
<td>Senior Seminar, H.Ec. 420A</td>
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<tr>
<td>Pattern Making and Clothing Construction, T.C. 125</td>
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<td>Select from F.E. 340, 385, 470, 485</td>
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<td>Select from other home economics courses</td>
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<tr>
<td><strong>Biological Sciences</strong></td>
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<tr>
<td>Select from bacteriology, human physiology, biology</td>
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<tr>
<td><strong>Physical Sciences</strong></td>
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<tr>
<td>General Chemistry, Chem. 141, 142</td>
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<tr>
<td>Laboratory in General Chemistry, Chem. 141L, 142L</td>
<td>2</td>
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<tr>
<td>Elementary Organic Chemistry, Chem. 231</td>
<td>3</td>
</tr>
<tr>
<td>Laboratory in Elementary Organic Chemistry, Chem. 232C</td>
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<tr>
<td><strong>Social Sciences</strong></td>
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<tr>
<td>Select at least 6 credits each from four of the groups listed below</td>
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<tr>
<td>Anthropology</td>
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<tr>
<td>The Family in Cross-Cultural Perspective, Anthro. 313</td>
<td>3</td>
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<tr>
<td>Comparative Studies of World Cultures, Anthro. 321</td>
<td>3</td>
</tr>
<tr>
<td>Anthropological Perspectives of Religion, Anthro. 340</td>
<td>3</td>
</tr>
<tr>
<td>Language and Culture, Anthro. 400</td>
<td>3</td>
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<tr>
<td>Culture and Personality, Anthro. 422</td>
<td>3</td>
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<tr>
<td>Ethnology of the Old World, Anthro. 424</td>
<td>3</td>
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<tr>
<td>Culture Change, Anthro. 425</td>
<td>3</td>
</tr>
<tr>
<td>Economics</td>
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<tr>
<td>Comparative Economic Systems, Econ. 306</td>
<td>3</td>
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<tr>
<td>Economics of Underdeveloped Nations, Econ. 411</td>
<td>3</td>
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<tr>
<td>International Economics, Econ. 455</td>
<td>3</td>
</tr>
<tr>
<td>International Finance, Econ. 456</td>
<td>3</td>
</tr>
<tr>
<td>Geography</td>
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<tr>
<td>World Geography, Geog. 201</td>
<td>3</td>
</tr>
<tr>
<td>Economic Geography, Geog. 322</td>
<td>3</td>
</tr>
<tr>
<td>Cultural Geography—European and American, Geog. 324</td>
<td>3</td>
</tr>
<tr>
<td>Cultural Geography—African, Asian, Australian and Pacific Islands, Geog. 325</td>
<td>3</td>
</tr>
</tbody>
</table>

Colleges and Curricula
History
History of United States Foreign Policy, Hist. 477A, 477B, 477C................................. 3 credits (each)

Journalism
International Communication and the Foreign Press, Jl. 440........................................ 3 credits
Mass Communication in Developing Nations, Jl. 545....................................................... 3 credits

Political Science
Introduction to International Politics, Pol.S. 251............................................................. 3 credits
Politics of Developing Areas, Pol.S. 340............................................................................. 3 credits
Comparative Foreign Policies, Pol.S. 452.......................................................................... 3 credits
International Organizations, Pol.S. 453............................................................................ 3 credits
United States Foreign Policy, Pol.S. 458............................................................................ 3 credits

Sociology
Introduction to Social Ecology and Population Studies, Soc. 304...................................... 3 credits
Social Stratification, Soc. 330............................................................................................ 3 credits
Societal Change and Development, Soc. 391..................................................................... 3 credits
Adoption and Diffusion of Innovations, Soc. 392............................................................. 3 credits
Urban Sociology, Soc. 410.............................................................................................. 3 credits

Select 6 credits in the study of a single non-European area.............................................. 6 credits

Africa and the Middle East
Introduction to Africa, D St. 204, 205, 206....................................................................... 3 credits (each)
Politics of the Middle East, Pol.S. 445............................................................................... 3 credits (each)
Governments of Africa South of the Sahara, Pol.S. 446A, 446B........................................ 3 credits (each)

Asia
Introduction to East Asia, D St. 207, 208, 209............................................................... 3 credits (each)
History of China, Hist. 340, 341....................................................................................... 3 credits (each)
Modern Japanese History, Hist. 443.................................................................................. 3 credits (each)
Religions of Western Asia, Phil. 351.................................................................................. 3 credits (each)
Religions of Southern and Southeastern Asia, Phil. 352.................................................. 3 credits (each)
Religions of East Asia, Phil. 353....................................................................................... 3 credits (each)
Governments of China and Japan, Pol.S. 442A............................................................... 3 credits (each)
Governments of India, Pakistan, and Southeast Asia, Pol.S. 442B................................... 3 credits (each)
Asia in World Affairs, Pol.S. 451...................................................................................... 3 credits (each)

Latin America
Introduction to Latin America, D St. 201, 202, 203.......................................................... 3 credits (each)
Contemporary Latin American Cultures, Anthro. 323...................................................... 3 credits (each)
Native Peoples of Middle and South America, Anthro. 325............................................ 3 credits (each)
Spanish and Ibero-American Civilization, F L 359.......................................................... 3 credits (each)
Introduction to Spanish American Literature, F. L. 464, 465, 466.................................... 3 credits (each)
History of Latin America, Hist. 350, 351, 352.................................................................. 3 credits (each)
Inter-American Relations, Hist. 479A, 479B................................................................... 3 credits (each)

Russia
Russian Civilization, F L 327, 328, 329............................................................................ 3 credits (each)
History of Russia, Hist. 416C............................................................................................. 3 credits
U.S.-Soviet Relations, Hist. 478......................................................................................... 3 credits
Government and Politics of the Soviet Union, Pol.S. 444............................................... 3 credits
Russian Political Thought and Institutions, Pol.S. 544.................................................... 3 credits
Soviet Foreign Policy, Pol.S. 556....................................................................................... 3 credits

Western Europe
French Civilization, F L 316............................................................................................. 3 credits
German Civilization, F.L. 338.......................................................................................... 3 credits
Contemporary Europe, Hist. 410A, 410B, 410C................................................................ 3 credits (each)
History of Modern Germany, Hist. 517B......................................................................... 3 credits

Language (in one language)............................................................................................... 21 credits
Seminar in International Studies, U St. 430 (to be taken during the student's junior or senior year)......................................................................................................................... 3 credits

Written and Spoken English............................................................................................. 11 credits

Library Instruction, Lib. 160.............................................................................................. 1 credit

Physical Education............................................................................................................. 3 credits

Electives (including prerequisites)..................................................................................... 50-51 credits
### Curriculum in Home Economics Education

Leading to the degree Bachelor of Science. Total credits required—195.

The curriculum is planned for those who wish to prepare for teaching home economics in junior and senior high schools or in other educational programs.

Further information appears under *College of Education*.

<table>
<thead>
<tr>
<th>Home Economics Core</th>
<th>17 credits</th>
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<tbody>
<tr>
<td>Applied Art:</td>
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<tr>
<td>Design, A.A. 103</td>
<td>4 credits</td>
</tr>
<tr>
<td>Equipment and Housing</td>
<td>3 credits</td>
</tr>
<tr>
<td>Select from F.E. 254, F.E. 318</td>
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</tr>
<tr>
<td>Family and the Child</td>
<td>3 credits</td>
</tr>
<tr>
<td>Select from F.E. 285, F.E. 385</td>
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<tr>
<td>Management:</td>
<td>3 credits</td>
</tr>
<tr>
<td>Select from F.E. 375, I Mgt. 287</td>
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</tr>
<tr>
<td>Nutrition:</td>
<td></td>
</tr>
<tr>
<td>Nutrition and the Family’s Food, F &amp; N. 107</td>
<td>4 credits</td>
</tr>
<tr>
<td>Professional Relations, H Ec. 400</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Home Economics</th>
<th>50-51 credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fundamentals of Interior Design, A A 261</td>
<td>3 credits</td>
</tr>
<tr>
<td>Principles of Child Development, C D 236</td>
<td>3 credits</td>
</tr>
<tr>
<td>Development and Guidance in Later Childhood, C D 337</td>
<td>3 credits</td>
</tr>
<tr>
<td>Consumer Behavior, F E 415 (3 cr.)</td>
<td>3 credits</td>
</tr>
<tr>
<td>or</td>
<td></td>
</tr>
<tr>
<td>Family Finance, F.E. 488 (3 cr.)</td>
<td>3 credits</td>
</tr>
<tr>
<td>or</td>
<td></td>
</tr>
<tr>
<td>Quantity Food Production Management, I Mgt. 380 (4 cr.)</td>
<td>3-4 credits</td>
</tr>
<tr>
<td>Principles of Food Preparation, F &amp; N. 208</td>
<td>5 credits</td>
</tr>
<tr>
<td>Family Meal Management, F &amp; N. 303</td>
<td>4 credits</td>
</tr>
<tr>
<td>Housing:</td>
<td>3 credits</td>
</tr>
<tr>
<td>Select from A.A. 262; Arch. 361; F.E. 240, 308, 412, 445, 446, 521</td>
<td></td>
</tr>
<tr>
<td>Textiles, T&amp;C. 104</td>
<td>4 credits</td>
</tr>
<tr>
<td>Pattern Making and Clothing Construction, T&amp;C. 125</td>
<td>4 credits</td>
</tr>
<tr>
<td>Clothing Selection, T&amp;C. 245</td>
<td>3 credits</td>
</tr>
<tr>
<td>Area of Concentration:</td>
<td>12 credits</td>
</tr>
<tr>
<td>Select 12 credits from home economics or in one area of concentration:</td>
<td></td>
</tr>
<tr>
<td>food and nutrition; institution management; housing and equipment;</td>
<td></td>
</tr>
<tr>
<td>human development and the family; home management and family</td>
<td></td>
</tr>
<tr>
<td>economics; or textiles and clothing.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Professional Education</th>
<th>36 credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Foundations of American Education, Educ. 204</td>
<td>3 credits</td>
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<tr>
<td>Methods of Teaching, Educ. 305A, 305B</td>
<td>4 credits</td>
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<tr>
<td>Principles of Secondary Education, Educ. 426</td>
<td>3 credits</td>
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<tr>
<td>Methods of Teaching Home Economics, H Ed. 406</td>
<td>4 credits</td>
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<tr>
<td>Supervised Teaching in Home Economics, H.Ed. 407</td>
<td>9 credits</td>
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<tr>
<td>Planning and Evaluating Home Economics Programs, H.Ed. 410</td>
<td>4 credits</td>
</tr>
<tr>
<td>Supervised Experiences in Home Economics Education, H Ed. 417</td>
<td>3 credits</td>
</tr>
<tr>
<td>Developmental Psychology, Psych. 230</td>
<td>3 credits</td>
</tr>
<tr>
<td>Educational Psychology, Psych. 333</td>
<td>3 credits</td>
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</table>

<table>
<thead>
<tr>
<th>Biological Sciences</th>
<th>8 credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Select from bacteriology, biochemistry and biophysics, biology, botany,</td>
<td></td>
</tr>
<tr>
<td>genetics, human physiology, or zoology</td>
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</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Physical Sciences</th>
<th>16 credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>General Chemistry, Chem. 141, 142</td>
<td>6 credits</td>
</tr>
<tr>
<td>Laboratory in General Chemistry, Chem. 141L, 142L</td>
<td>2 credits</td>
</tr>
<tr>
<td>Elementary Organic Chemistry, Chem. 231</td>
<td>3 credits</td>
</tr>
<tr>
<td>Laboratory in Elementary Organic Chemistry, Chem. 232C</td>
<td>1 credit</td>
</tr>
<tr>
<td>Elementary Physics, Phys. 106</td>
<td>4 credits</td>
</tr>
</tbody>
</table>
### Curriculum in Home Economics Journalism

Administered by the dean of the College of Home Economics.

Leading to the degree Bachelor of Science. Total credits required—195.

A variety of positions is open to graduates who combine home economics and journalism. Such positions include editorial, advertising, radio and television, and public relations work in media, industries, and institutions associated with home economics.

Students in home economics with a major in journalism have opportunities for practical experience through work on campus publications, including Outlook, published by home economics students. Many students also lay foundations for active careers by contributing to magazines and newspapers and by participating in productions for the University stations WO1-AM, FM and TV.

#### Home Economics Core (Select courses in each area)

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Art, Textiles and Clothing</td>
<td>3</td>
</tr>
<tr>
<td>Equipment and Housing</td>
<td>3</td>
</tr>
<tr>
<td>Family and the Child</td>
<td>3</td>
</tr>
<tr>
<td>Management</td>
<td>3</td>
</tr>
<tr>
<td>Nutrition</td>
<td>3</td>
</tr>
<tr>
<td>Professional Relations, H.Ec. 400</td>
<td>R</td>
</tr>
</tbody>
</table>

#### Home Economics

- Senior Seminar, H.Ec. 420B: 1 credit
- Home Economics (concentration of a minimum of 20 credits in one area): 20 credits

#### Journalism and Mass Communication

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction to Mass Communication, JI. 101</td>
<td>2</td>
</tr>
<tr>
<td>Basic Reporting, Writing, Editing, JI. 201, 202, 203</td>
<td>11 credits</td>
</tr>
<tr>
<td>A minimum of four 300-level courses</td>
<td>12-14</td>
</tr>
<tr>
<td>A minimum of three 400-level courses</td>
<td>9</td>
</tr>
</tbody>
</table>

#### Biological Sciences

- 8 credits

#### Physical Sciences

- 8 credits

#### Social Sciences

- 15 credits

#### American history or American government

- 3 credits

#### Humanities

- 15 credits

#### Written and Spoken English

- 11 credits

#### Library Instruction, Lib. 160

- 1 credit

#### Physical Education

- 3 credits

#### Electives

- 62-64 credits

### Notes

1. Humanities selection must include 3 credits of American history, or the social science selection must include Pol.S. 215.

2. In addition to the 195 credits required for graduation, all students must fulfill the JI. 4901 professional work requirement. It involves 3 months full-time work, or equivalent, in professional mass communication (6 cr.).
Curriculum in Institution Management

Leading to the degree Bachelor of Science. Total credits required—195.
The three majors within the institution management curriculum—college food and housing administration, hotel and restaurant management, and school food service—meet the academic requirements for membership in the American Dietetic Association and qualify the student for an internship approved by the Association. Graduates of this curriculum are also eligible for membership in national associations representing the hotel, restaurant, and school food-service industries.

By careful planning of program and use of electives, a student majoring in school food service may meet the certification requirements for teaching home economics in high school.

### Core Curriculum Requirements

<table>
<thead>
<tr>
<th>Category</th>
<th>Courses</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>Home Economics Core</td>
<td>Applied Art, Textiles and Clothing, Select from A.A. 103, 384</td>
<td>3-4</td>
</tr>
<tr>
<td></td>
<td>Equipment and Housing, Layout and Equipment, I Mgt. 485</td>
<td>4</td>
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<tr>
<td></td>
<td>Family and the Child, Select from C D 236, F E 270, 285, 385</td>
<td>3-4</td>
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<tr>
<td></td>
<td>Management, Introduction to Institution Management, I Mgt. 287</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Nutrition, Nutrition and the Family’s Food, F &amp; N. 107</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Professional Relations, H.Ec. 400</td>
<td>R</td>
</tr>
<tr>
<td>Institution Management Core</td>
<td>Foods I, F &amp; N. 214</td>
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</tr>
<tr>
<td></td>
<td>Foods II, F &amp; N. 215</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Principles of Accounting I, I Ad. 384</td>
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<tr>
<td></td>
<td>Quantity Food Production Management, I Mgt. 380</td>
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<td></td>
<td>Study Tour, I Mgt. 400</td>
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<td></td>
<td>Seminar, I Mgt. 404</td>
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<td>Purchasing and Inventory Management, I Mgt. 484</td>
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<td>Institution Management Experience, I Mgt. 486A, 486B</td>
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<td>Organization and Management, I Mgt. 487</td>
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<td>Personnel Management in Institutions, I Mgt. 488</td>
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<td></td>
<td>Additional institution management</td>
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<tr>
<td></td>
<td>Textiles, T &amp; C 104</td>
<td>4</td>
</tr>
<tr>
<td>Biological Sciences</td>
<td>Introductory Bacteriology, Bact. 300</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Principles of Biology, Biol. 101</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Experimental Biology, Biol. 101A</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Elementary Human Physiology and Anatomy, Zool. 155</td>
<td>5</td>
</tr>
<tr>
<td>Physical Sciences</td>
<td>General Chemistry, Chem. 141, 142</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>Laboratory and General Chemistry, Chem. 141L, 142L</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Elementary Organic Chemistry, Chem. 231</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Laboratory in Elementary Organic Chemistry, Chem. 232B or 232C</td>
<td>1-2</td>
</tr>
<tr>
<td>Social Sciences</td>
<td>Principles of Economics, Econ. 241, 242</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>American Government, Pol.S. 215</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>General Psychology, Psych. 101</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Introduction to Sociology, Soc. 134</td>
<td>3</td>
</tr>
<tr>
<td>Humanities</td>
<td>Select from history, philosophy, literature, foreign languages, music</td>
<td>15</td>
</tr>
<tr>
<td>Written and Spoken English</td>
<td>Language in Composition and Reading, Engl. 104, 105</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>Fundamentals of Speech, Sp. 211</td>
<td>3</td>
</tr>
<tr>
<td>Library Instruction, Lib 160</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Physical Education</td>
<td></td>
<td>3</td>
</tr>
</tbody>
</table>
Major in College Food and Housing Administration

In addition to the core curriculum requirements, the following courses are to be completed:

Housing and Social Program Management, I Mgt. 486C, 486D .................................. 3 credits
House Administration, I Mgt. 489 ................................................................. 3 credits
Concentrations ........................................................................................................ 12-14 credits
Survey of Biochemistry, B & B 301 ................................................................. 3 credits
and
Methods of Teaching, Educ. 305A ................................................................. 3 credits
and
Nutrition and Dietetics, F & N 305 ................................................................. 4 credits
and
Experimental Studies of Food, F & N. 411 ...................................................... 4 credits
or
Labor Economics and Labor Relations, Econ. 305 ........................................... 3 credits
and
Business Law I, I Ad. 365D ................................................................. 3 credits
and
Hotel and Restaurant Accounting, I Mgt. 450 .............................................. 3 credits
and
Legal Aspects of Hotel and Restaurant Management, I Mgt. 460 ..................... 3 credits
Select from Educ. 204, 305A; Psych. 230, 333; Soc. 364, 380, 450 ...................... 9 credits
Electives ........................................................................................................... 33-38 credits

Major in Hotel and Restaurant Management

In addition to the core curriculum requirements, the following courses are to be completed:

Hotel and Restaurant Accounting, I Mgt. 450 .................................................. 3 credits
Legal Aspects of Hotel and Restaurant Management, I Mgt. 460 ....................... 3 credits
House Administration, I Mgt. 489 ................................................................. 3 credits
Business Law I, I Ad. 365D ................................................................. 3 credits
Architectural Technologies I, Arch 341 ......................................................... 3 credits
Elementary Physics, Phys. 106 (4 cr.) ............................................................. 4 credits
or
General Physics, Phys. 111 (4 cr.) ................................................................. 4 credits
Labor: Select from Econ. 305, 445; I.E. 423, 424, 425................................... 6 credits
Finance: Select from I.Ad. 350, 385, 425, 445; Stat. 127................................. 6 credits
Sales and Public Relations: Select from Engl. 404; I.Ad. 340; Psych. 250; Jr. 225. 2-3 credits
Electives ........................................................................................................... 28-32 credits

Major in School Food Service

In addition to the core curriculum requirements, the following courses are to be completed:

Survey of Biochemistry, B & B 301 ................................................................. 3 credits
Methods of Teaching, Educ. 305A, 305B ........................................................ 4 credits
Nutrition and Dietetics, F & N. 305 ................................................................. 4 credits
Experimental Studies of Food, F & N. 411 ...................................................... 4 credits
Education: Select from Educ. 204, 426; Psych. 230, 333 ............................... 4 credits
Food and Nutrition: Select from F & N. 409, 410, 413, 414, 418 .................... 6 credits
Electives ........................................................................................................... 32-35 credits

Technical Institute in Food Service Management

For the outline of courses for the two-year Technical Institute in food service management, see Index, Technical Institute. The graduate is qualified as an associate in food service management. The six quarters of study include courses related to business management and large quantity food production and service, as well as courses which contribute to a general education.

The Technical Institute program is designed to prepare men and women for middle management career positions in all phases of food service. One purpose of the program is to help establish standards for technical food service education in Iowa. Enrollment is limited to a maximum of 20 new students each year.
Curriculum in Physical Education for Women

Leading to the degree Bachelor of Science. Total credits required—195.

See College of Sciences and Humanities for group requirements leading to a degree through the College of Sciences and Humanities.

The curriculum in physical education for women prepares the student to teach physical education and/or dance in the elementary and secondary schools. Other opportunities include professional work in related areas.

### Core Curriculum Requirements

<table>
<thead>
<tr>
<th>Course Description</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Physical Education</strong></td>
<td></td>
</tr>
<tr>
<td>Square Dance, P.E.W. 118</td>
<td>1 credit</td>
</tr>
<tr>
<td>Fundamentals of Modern Dance, P.E.W. 165</td>
<td>1 credit</td>
</tr>
<tr>
<td>Introduction to Physical Education, P.E.W 190</td>
<td>3 credits</td>
</tr>
<tr>
<td>Fundamentals of Physical Education Activities, P.E.W. 251</td>
<td>1 credit</td>
</tr>
<tr>
<td>Program Development in Physical Education, P.E.W. 275</td>
<td>3 credits</td>
</tr>
<tr>
<td>Principles of Motor Performance, P.E.W. 370</td>
<td>4 credits</td>
</tr>
<tr>
<td>Professional Relations, P.E.W. 399</td>
<td>R</td>
</tr>
<tr>
<td>Evaluation in Physical Education, P.E.W. 452</td>
<td>4 credits</td>
</tr>
<tr>
<td>Scientific Bases of Physical Education, P.E.W. 480</td>
<td>4 credits</td>
</tr>
<tr>
<td><strong>Health Education</strong></td>
<td></td>
</tr>
<tr>
<td>Nutrition and the Family’s Food, F &amp;N 107</td>
<td>4 credits</td>
</tr>
<tr>
<td>Personal Health Education, Hyg. 104</td>
<td>4 credits</td>
</tr>
<tr>
<td>School Health Education, Hyg. 304</td>
<td>3 credits</td>
</tr>
<tr>
<td><strong>Professional Education</strong></td>
<td></td>
</tr>
<tr>
<td>Foundations of American Education, Educ 204</td>
<td>3 credits</td>
</tr>
<tr>
<td>Methods of Teaching, Educ. 305A, 305B</td>
<td>4 credits</td>
</tr>
<tr>
<td>Principles of Secondary Education, Educ. 426</td>
<td>3 credits</td>
</tr>
<tr>
<td>Physical Education for the Elementary School Child, P.E.W 259</td>
<td>2 credits</td>
</tr>
<tr>
<td>Methods of Teaching Gymnastics and Modern Dance, P.E.W 376</td>
<td>2 credits</td>
</tr>
<tr>
<td>Techniques and Methods of Social, Folk, and Square Dance, P.E.W 385</td>
<td>2 credits</td>
</tr>
<tr>
<td>Developmental Psychology, Psych. 230</td>
<td>3 credits</td>
</tr>
<tr>
<td>Educational Psychology, Psych. 333</td>
<td>3 credits</td>
</tr>
<tr>
<td>Supervised Teaching in Physical Education in Secondary Schools, P.E.W 417</td>
<td>4-12 credits</td>
</tr>
</tbody>
</table>

(Must take at least 9 credits if receiving secondary certification)

<table>
<thead>
<tr>
<th>Course Description</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Biological Sciences</strong></td>
<td></td>
</tr>
<tr>
<td>Elementary Human Physiology and Anatomy, Zool. 155</td>
<td>5 credits</td>
</tr>
<tr>
<td>Kinesiology, Zool. 359</td>
<td>5 credits</td>
</tr>
<tr>
<td><strong>Social Sciences</strong></td>
<td></td>
</tr>
<tr>
<td>Principles of Economics, Econ. 241</td>
<td>3 credits</td>
</tr>
<tr>
<td>American Government, Pol.s. 215</td>
<td>3 credits</td>
</tr>
<tr>
<td>General Psychology, Psych. 101</td>
<td>3 credits</td>
</tr>
<tr>
<td>Introduction to Sociology, Soc. 134</td>
<td>3 credits</td>
</tr>
<tr>
<td><strong>Humanities</strong></td>
<td></td>
</tr>
<tr>
<td>Introduction to Literature, Engl. 201</td>
<td>3 credits</td>
</tr>
<tr>
<td>Introduction to Listening, Music 104 (3 cr.) or Introduction to Music Literature, Music 102 (2 cr.)</td>
<td>2-3 credits</td>
</tr>
<tr>
<td>History</td>
<td>6 credits</td>
</tr>
<tr>
<td><strong>Library Instruction, Lib. 160</strong></td>
<td>1 credit</td>
</tr>
<tr>
<td><strong>Art</strong></td>
<td></td>
</tr>
<tr>
<td>Select from applied art</td>
<td>3 credits</td>
</tr>
<tr>
<td><strong>Written and Spoken English</strong></td>
<td></td>
</tr>
<tr>
<td>Language in Composition and Reading, Engl. 104, 105</td>
<td>8 credits</td>
</tr>
<tr>
<td>Fundamentals of Speech, Sp. 211</td>
<td>3 credits</td>
</tr>
</tbody>
</table>

**Total Credits:** 21 credits + 11 credits + 26-34 credits (as per specific requirements) + 10 credits + 12 credits + 11-12 credits + 3 credits + 3 credits + 1 credit + 3 credits + 11 credits + 8 credits + 3 credits = 195 credits
Major in Physical Education for Women

In addition to the core curriculum requirements, the following courses are to be completed to meet the requirements for secondary certification:

Physical Education for Women.................................................................18 credits
- Fundamentals of Physical Education Activities, P.E.W 150, 151, 152, 250, 252........5 credits
- P.E.W. swimming elective.................................................................1 credit
- Officiating, P.E.W. 270 or 271.......................................................2 credits
- Methods of Teaching Team Sports, P.E.W. 375.................................2 credits
- Methods of Teaching Individual Sports, P.E.W. 377.............................2 credits
- Organization of Physical Education Programs, P.E.W. 420.....................3 credits
- History and Philosophy of Physical Education, P.E.W. 440.....................3 credits

Biological Sciences.............................................................................6 credits
- Principles of Biology, Biol. 101.......................................................3 credits
- Environmental Biology, Biol. 103....................................................3 credits

Physical Sciences.............................................................................11 credits
- General Chemistry, Chem. 141, 141L, 142, 142L.................................8 credits
- Select from physical sciences or mathematics.....................................3 credits

Social Sciences..................................................................................6 credits
- Communicative Arts.........................................................................3 credits
- Electives..........................................................................................36-40 credits

Major in Physical Education - Dance Option

In addition to the core curriculum requirements, the following courses are to be completed:

Design, A.A. 103..................................................................................4 credits

General Education............................................................................23 credits
- Physical science or mathematics......................................................9.21 credits
- Biological sciences.........................................................................0.11 credits
- Social sciences..............................................................................0.9 credits
- Humanities.....................................................................................0.7 credits
- Communicative arts........................................................................3.4 credits

Physical Education for Women..........................................................19-24 credits
- Folk Dance, P.E.W. 117...................................................................1 credit
- Composition, Techniques, Advanced Modern Dance, and Concert Dance,
  P.E.W. 220, 222, 223, 224...........................................................4 credits
- History and Philosophy of Dance, P.E.W. 380....................................3 credits
- Advanced Studies in Dance, P.E.W. 382...........................................4 credits
- Methods of Teaching Modern Dance: Technique and Composition, P.E.W. 386
  Select from.....................................................................................3 credits
- Fundamentals of Physical Education Activities, P.E.W. 150, 152 (2 cr.)
  and
  Methods of Teaching Individual Sports, P.E.W. 377 (2 cr.)
  or
  Fundamentals of Physical Education Activities, P.E.W. 151, 250 (2 cr.)
  and
  Methods of Teaching Team Sports, P.E.W. 375 (2 cr.)
  or
  P.E.W. Electives in Swimming (2 cr.)
  and
  Methods of Teaching Aquatics, P.E.W. 379 (2 cr.)

Electives..........................................................................................29-38 credits

Certification to Teach Physical Education in Elementary Schools

In addition to the requirements of the major program leading to secondary school certification, students desiring to receive kindergarten through twelfth grade certification in physical education must complete the following courses:
<table>
<thead>
<tr>
<th>Course Description</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Development and Guidance in Later Childhood, CD 337</td>
<td>3 credits</td>
</tr>
<tr>
<td>Principles of Teaching in the Elementary Schools, EL.Ed. 344A</td>
<td>2 credits</td>
</tr>
<tr>
<td>Creative Rhythmic Activities for Elementary School Children, PEW 260</td>
<td>2 credits</td>
</tr>
<tr>
<td>Games and Activities for Elementary School Children, PEW 261</td>
<td>2 credits</td>
</tr>
<tr>
<td>Supervised Teaching in Physical Education in the Elementary Schools, PEW 418</td>
<td>2.5 credits</td>
</tr>
<tr>
<td>(May satisfy 2-5 credits of requirement for PEW 417, Supervised Teaching of Physical Education)</td>
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</tr>
<tr>
<td>Music in Elementary Education, Music 365</td>
<td>3 credits</td>
</tr>
<tr>
<td>Select from child development, music, physical education</td>
<td>3 credits</td>
</tr>
</tbody>
</table>
Curriculum in Textiles and Clothing

Leading to the degree Bachelor of Science. Total credits required—195.

The department offers majors in textiles and clothing, and textiles and clothing and related science. Options within each major permit the student to plan a program suited to individual interest.

Courses required of all textiles and clothing majors:

### Core Curriculum Requirements

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Home Economics Core.</strong></td>
<td></td>
</tr>
<tr>
<td>Applied Art, Textiles and Clothing.</td>
<td>4</td>
</tr>
<tr>
<td>A A 103</td>
<td></td>
</tr>
<tr>
<td>Equipment and Housing.</td>
<td>3</td>
</tr>
<tr>
<td>Select from A.A. 261; F.E. 240, 254, 308, 318, 408</td>
<td></td>
</tr>
<tr>
<td>Family and the Child.</td>
<td>3</td>
</tr>
<tr>
<td>Select from C.D. 236; F.E. 185, 270, 285, 385</td>
<td></td>
</tr>
<tr>
<td>Management.</td>
<td>3</td>
</tr>
<tr>
<td>Select from F.E. 375, 415, 488, I Mgt. 287</td>
<td></td>
</tr>
<tr>
<td>Nutrition.</td>
<td>3-4</td>
</tr>
<tr>
<td>Select from F. &amp; N. 107, 232</td>
<td></td>
</tr>
<tr>
<td><strong>Textiles and Clothing Core.</strong></td>
<td>13-14</td>
</tr>
<tr>
<td>Textiles, T &amp; C. 104</td>
<td>4</td>
</tr>
<tr>
<td>Pattern Making and Clothing Construction, T &amp; C. 125</td>
<td>4</td>
</tr>
<tr>
<td>Sophomore Seminar, T &amp; C. 210</td>
<td>1</td>
</tr>
<tr>
<td>Clothing Selection, T &amp; C. 245</td>
<td>3</td>
</tr>
<tr>
<td>Senior Study Tour, T &amp; C. 401</td>
<td>R or 1</td>
</tr>
<tr>
<td>Senior Seminar, T &amp; C. 410</td>
<td>1</td>
</tr>
<tr>
<td><strong>Biological Science.</strong></td>
<td>8</td>
</tr>
<tr>
<td>Elements of Human Physiology and Anatomy, Zool. 155 (5 cr.)</td>
<td></td>
</tr>
<tr>
<td>or Principles of Biology, Biol. 101 (3 cr.) and</td>
<td>5</td>
</tr>
<tr>
<td>Experimental Biology, Biol. 101A (2 cr.)</td>
<td></td>
</tr>
<tr>
<td>Additional credits</td>
<td>3</td>
</tr>
<tr>
<td><strong>Physical Sciences and Mathematics.</strong></td>
<td>15</td>
</tr>
<tr>
<td>General Chemistry, Chem. 141, 142</td>
<td>6</td>
</tr>
<tr>
<td>Laboratory in General Chemistry, Chem. 141L, 142L</td>
<td>2</td>
</tr>
<tr>
<td>Elementary Organic Chemistry, Chem. 231</td>
<td>3</td>
</tr>
<tr>
<td>Laboratory in Elementary Organic Chemistry, Chem. 232C</td>
<td>1</td>
</tr>
<tr>
<td>Mathematics</td>
<td>3</td>
</tr>
<tr>
<td><strong>Social Science.</strong></td>
<td>15</td>
</tr>
<tr>
<td>Principles of Economics, Econ. 241, 242</td>
<td>6</td>
</tr>
<tr>
<td>General Psychology, Psych. 101</td>
<td>3</td>
</tr>
<tr>
<td>Introduction to Sociology, Soc. 134</td>
<td>3</td>
</tr>
<tr>
<td>Select from anthropology, economics, political science, psychology, sociology...</td>
<td>3</td>
</tr>
<tr>
<td><strong>Humanities.</strong></td>
<td>15</td>
</tr>
<tr>
<td>Study of Western Civilization, Hist. 201, 202</td>
<td>6</td>
</tr>
<tr>
<td>Additional credits</td>
<td>9</td>
</tr>
<tr>
<td><strong>Written and Spoken English.</strong></td>
<td>11</td>
</tr>
<tr>
<td>Language in Composition and Reading, Engl. 104, 105</td>
<td>8</td>
</tr>
<tr>
<td>Fundamentals of Speech, Sp. 211 (3 cr.)</td>
<td></td>
</tr>
<tr>
<td>or Voice and Diction, Sp. 207 (3 cr.)</td>
<td>3</td>
</tr>
<tr>
<td>Library Instruction, Lib. 160</td>
<td>1</td>
</tr>
<tr>
<td>Physical Education</td>
<td>3</td>
</tr>
</tbody>
</table>
Major in Textiles and Clothing

This major may lead to careers in merchandising, fashion promotion, commercial or costume designing, or educational positions with industry.

In addition to the core curriculum requirements, the following courses are to be completed:

**Drawing, A.A.** 150 ........................................ 3 credits
**Fashion Illustration, A.A.** 278 ........................................ 3 credits
**Business Communication, Engl. 404** ........................................ 2 credits
**Principles of Marketing, I Ad. 340 (3 cr.)**

or

**Retailing, Econ. 466 (3 cr.)** ........................................ 3 credits

**Business Law I, I Ad. 365** ........................................ 3 credits

**Principles of Accounting I, I Ad. 384** ........................................ 4 credits

**Draping, T & C 225** ........................................ 4 credits

**Costume Design, T & C 345** ........................................ 3 credits

Select from II. 225, 325; Psych 250 ........................................ 3 credits

**Design Option**

**Fashion Illustration, A.A.** 279 ........................................ 3 credits

**History of Art, A.A.** 301, 302, 303 ........................................ 9 credits

**Textile Design, A.A.** 347 (4 cr.) ........................................ 3 credits

or

**Applied Textiles, T & C 304 (3 cr.)** ........................................ 3-4 credits

**Children’s Clothing, T & C 326 (2-4 cr)** ........................................ 3 credits

or

**Custom Tailoring, T & C 429 (4 cr.)** ........................................ 2-4 credits

**Historic Textiles, T & C 414** ........................................ 3 credits

**History of Costume, T & C 454** ........................................ 3 credits

**Introduction to Sociological and Psychological Aspects of Clothing and Textiles, T & C 465** ........................................ 3 credits

**Electives** ........................................ 3 credits

**Merchandising Option**

**Fundamentals of Interior Design, A.A.** 261 ........................................ 3 credits

**Labor Economics and Labor Relations, Econ. 305 (3 cr.)** ........................................ 3 credits

or

**Social Relations in Industry, Soc. 380 (3 cr.)** ........................................ 3 credits

**Applied Textiles, T & C 304** ........................................ 3 credits

**Textiles and Clothing Merchandising, T & C 365** ........................................ 3 credits

**Advanced Textiles, T & C 404** ........................................ 3 credits

Select from T & C 414, 454; A.A. 384 ........................................ 6 credits (total)

**Family Clothing Consumption, T & C 464** ........................................ 3 credits

**Electives** ........................................ 46-48 credits

Major in Textiles and Clothing and Related Science

This major prepares the student for graduate study or for research.

The two options make it possible to emphasize either the physical or the social sciences.

In addition to the core curriculum requirements, the following courses are to be completed:

**Precalculus Mathematics, Math. 109** ........................................ 5 credits

**Analytic Geometry and Calculus I, II; Math 110, 111** ........................................ 10 credits

**Writing of Reports and Technical Papers, Engl. 414** ........................................ 3 credits

**Foreign Language** ........................................ 12 credits

**Principles of Statistics, Stat. 101** ........................................ 5 credits

**Physical Science Option—Textiles**

**Applied Textiles, T & C 304** ........................................ 3 credits

**Advanced Textiles, T & C 404** ........................................ 3 credits

**Historic Textiles, T & C 414** ........................................ 3 credits

**Equipment for Care of Modern Fabrics, F & E 408** ........................................ 4 credits
<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introductory Bacteriology, Bact. 300</td>
<td>5</td>
</tr>
<tr>
<td>Quantitative Analysis, Chem. 211</td>
<td>5</td>
</tr>
<tr>
<td>Organic Chemistry, Chem. 334, 335</td>
<td>6</td>
</tr>
<tr>
<td>General Physics, Phys. 111, 112</td>
<td>8</td>
</tr>
<tr>
<td>Electives</td>
<td>25-27</td>
</tr>
<tr>
<td><strong>Social Science Option—Clothing</strong></td>
<td></td>
</tr>
<tr>
<td>Introduction to Sociological and Psychological Aspects of Clothing and Textiles, T &amp; C 465</td>
<td>3</td>
</tr>
<tr>
<td>History of Costume, T &amp; C. 454</td>
<td>3</td>
</tr>
<tr>
<td>Family Clothing Consumption, T &amp; C 464</td>
<td>3</td>
</tr>
<tr>
<td>Survey of Art, A.A. 384 (3 cr.)</td>
<td></td>
</tr>
<tr>
<td>or</td>
<td></td>
</tr>
<tr>
<td>Historic Textiles, T &amp; C. 414 (3 cr.)</td>
<td>3</td>
</tr>
<tr>
<td>Prices and Resource Allocation, Econ. 307, 308</td>
<td>6</td>
</tr>
<tr>
<td>Family Needs and Services in American Culture (will satisfy family and the child core requirement), F E. 285</td>
<td>3</td>
</tr>
<tr>
<td>Family Finance, F. E. 488 (will satisfy management option)</td>
<td>3</td>
</tr>
<tr>
<td>Sociological Inquiry, Soc. 202 (will satisfy social science option electives)</td>
<td>3</td>
</tr>
<tr>
<td>Select from Soc. 201, 305, 330</td>
<td>3</td>
</tr>
<tr>
<td>Learning and Motivation, Psych. 206</td>
<td>3</td>
</tr>
<tr>
<td>Select from Psych. 230, 380, 440</td>
<td>3</td>
</tr>
<tr>
<td>Electives</td>
<td>25-27</td>
</tr>
</tbody>
</table>
Education in the sciences and humanities is basic to all human endeavor. The College of Sciences and Humanities offers opportunities for study in many fields of the mathematical, physical, biological, and social sciences; in languages; in history, literature, and philosophy; and in the arts. The degree requirements of the College are sufficiently flexible to permit planning individual programs of study suited for many different interests, abilities, and goals. This study can serve as preparation for a great variety of careers and as the foundation for a life of continuing personal development and accomplishment.

**Curriculum in Sciences and Humanities**

For the degrees Bachelor of Arts and Bachelor of Science the student must earn a total of at least 192 credits, which shall include the following:

1. At least 99 credits in general education.
2. At least 30 additional credits in a major subject.
3. At least 21 additional credits in one minor subject, or a total of at least 27 additional credits in two minor subjects.
4. At least 3 credits in basic physical education courses.
5. A course in library science (normally Lib. 160).
6. Sufficient additional credits in elective courses to bring the total to at least 192. (Not more than 6 credits in basic physical education courses, nor more than 6 credits in 100-level music performance groups may be included among the required 192 credits unless required in a music major.)

A cumulative grade average of at least 2.00 is required for graduation. Students are expected to achieve a passing grade in every course pursued in this College.

Each student plans his own program of study with the guidance of a faculty adviser from his major department. A formal degree program showing all courses taken or to be taken in fulfillment of the degree requirements must be submitted not later than four quarters before graduation. This must be approved by the department chairman or head of the student’s major department and by the dean of the College of Sciences and Humanities.

**The General Education Requirement**

To insure breadth of educational experience and to provide a foundation for later, more advanced work, each student must earn at least 99 credits in the basic areas of learning specified below. The number of credits in each group counted toward fulfillment of this requirement must lie within the range indicated.

1. **Written and spoken English**
   - Sp. 211.
   - Engl. 104 and 105 or 131 and 132.
   - Additional courses to be selected from Engl. 204, 205, 304A, 304B, 306A, 306B, 315, 414
   - 14-21 credits
2. **Mathematical sciences**
   - Select from computer science, mathematics, statistics
   - 9-21 credits
3. **Physical sciences**
   - Select from biochemistry, biophysics, chemistry, geology, metallurgy, meteorology, physics
   - 9-21 credits
4. **Biological sciences**
   - Select from bacteriology, biology, botany, genetics, zoology
   - 9-21 credits
5. Social sciences............. 9-21 credits
   Select from anthropology, economics, geography, industrial administration (except courses in accounting), political science, psychology, sociology

6. Humanities ................ 9-21 credits
   History, literature, philosophy

7. Foreign languages...... 12-21 credits
   At least 12 credits must be in one language

8. Arts......................... 9-21 credits

In addition to credits earned in the eight groups specified above, the student may also include among the required 99 credits as many as 9 credits in Distributed Studies 201 through 209.

The Major Requirement

The student must earn at least 30 credits in a major field in addition to any credits counted toward fulfilling the general education requirement. The major department must approve the course program and may set higher requirements than the minimum if it is deemed appropriate. The major shall be chosen from the following list, which also indicates the degrees offered in the respective majors. (See Index for page references to individual departmental statements.)

Major

<table>
<thead>
<tr>
<th>Bachelor of Arts</th>
<th>Bachelor of Science</th>
<th>Major</th>
<th>Bachelor of Arts</th>
<th>Bachelor of Science</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anthropology</td>
<td>x</td>
<td>Mathematics</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Bacteriology</td>
<td>x</td>
<td>Metallurgy</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Biochemistry</td>
<td>x</td>
<td>Meteorology</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Biology</td>
<td>x</td>
<td>Music</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Biophysics</td>
<td>x</td>
<td>Naval Science</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Botany</td>
<td>x</td>
<td>Philosophy</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chemistry</td>
<td>x</td>
<td>Physical Education for Men</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Computer Science</td>
<td>x</td>
<td>Physical Education for Women</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Earth Science</td>
<td>x</td>
<td>Physics</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Economics</td>
<td>x</td>
<td>Political Science</td>
<td>x</td>
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</tr>
<tr>
<td>English</td>
<td>x</td>
<td>Psychology</td>
<td>x</td>
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<tr>
<td>French</td>
<td>x</td>
<td>Russian</td>
<td>x</td>
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<tr>
<td>Geology</td>
<td>x</td>
<td>Sociology</td>
<td>x</td>
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<tr>
<td>German</td>
<td>x</td>
<td>Spanish</td>
<td>x</td>
<td></td>
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<tr>
<td>History</td>
<td>x</td>
<td>Speech</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Industrial Administration</td>
<td>x</td>
<td>Statistics</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>International Studies</td>
<td>x</td>
<td>Zoology</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Journalism and Mass Communication</td>
<td>x</td>
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</tbody>
</table>

Students who wish to do so may elect to complete a second major instead of meeting the minor requirement described below. The second major shall be chosen from the list of major fields given above or from major fields offered for the bachelor's degree in other colleges of the University. Both major departments must then approve the degree program.

A special program in international studies is available as a second major to students whose first major is in anthropology, economics, a foreign language, history, journalism and mass communication, political science, or sociology. For a complete description of this program see Index, International Studies Programs.

The Minor Requirement

The student who does not elect a double major must complete either one minor of at least 21 credits, or two minors having at least 12 credits each and totaling at least 27 credits. In either case each minor must be composed entirely of courses numbered 200 or above and must include at least 6 credits in courses numbered 300 or above. Credits counted toward fulfillment of the general education requirement cannot also be used in meeting the minor requirement. Minors may be chosen from the list of major fields given above, or from
the fields of Air Force aerospace studies, genetics, military science, telecommunicative arts, theatre, or from major fields offered in other colleges. A minor may include courses from two or more closely related fields if they form a strong and coherent program directed toward a definite educational objective.

The Distributed Studies Program

The distributed studies program offers the possibility of pursuing somewhat broader studies than the usual major-minor program. For a discussion of career opportunities in this program, see Index, Distributed Studies.

Instead of meeting the major and minor requirements, the student selects three fields appropriately related to his educational goals and develops concentrations of study in these fields which meet the following requirements. He must earn 15 to 24 credits in each field, with a total of at least 60 credits. All courses included must be numbered 200 or above, and at least two-thirds of the total credits must be in courses numbered 300 or above. In addition, at least two-thirds of all credits in electives must be in courses numbered 300 or above. All other degree requirements are the same as previously stated.

Planning the Program of Study

There is no fixed schedule of courses to be followed by students in the College of Sciences and Humanities. Each student plans a schedule with guidance from a faculty adviser. The schedule may vary widely, depending on the student's major field, special interests, and goals.

Only a few general rules can be given for planning. During the first year the student should complete English 104 and 105, Library 160, and 3 credits in basic physical education, and should make a substantial beginning on the general education requirements, a large part of which should have been completed by the end of the second year, and the foundation laid for advanced work in the major and minor(s). The third and fourth years are usually devoted mostly to completion of the major and minor requirements.

Because the student's entire program depends critically on the choice of major field, that choice should be made as soon as possible, but definitely not later than the end of the second year. The major can be changed, of course, but this may delay the ultimate completion of requirements for graduation.

Every student in the College of Sciences and Humanities is required to have at least 70 credits in courses numbered 300 or higher prior to receiving the bachelor's degree.

Curriculum in Chemistry

This curriculum leads to the degree Bachelor of Science and is an alternative to the curriculum in sciences and humanities with a major in chemistry. At least 196 credits, in accordance with the requirements specified below, must be earned for graduation.

<table>
<thead>
<tr>
<th></th>
<th>FALL QUARTER</th>
<th>WINTER QUARTER</th>
<th>SPRING QUARTER</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Credits</td>
<td>Freshman Year</td>
<td>Credits</td>
</tr>
<tr>
<td>Quantitative Analysis</td>
<td>Chem. 114</td>
<td>Quantitative Analysis</td>
<td>Chem. 115</td>
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<tr>
<td>Language in Composition and Reading</td>
<td>Engl. 104</td>
<td>Language in Composition and Reading</td>
<td>Engl. 105</td>
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<td>Physical Education</td>
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<td>Physical Education</td>
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<tr>
<td>Elective</td>
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<td>Elective</td>
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<td>18</td>
<td>18</td>
<td>18</td>
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</tbody>
</table>
### Colleges and Curricula

<table>
<thead>
<tr>
<th>FALL QUARTER</th>
<th>WINTER QUARTER</th>
<th>SPRING QUARTER</th>
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</thead>
<tbody>
<tr>
<td>Credits</td>
<td>Credits</td>
<td>Credits</td>
</tr>
<tr>
<td><strong>Sophomore Year</strong></td>
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</tr>
<tr>
<td>Organic Chemistry</td>
<td>Chem. 330, 331</td>
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</tr>
<tr>
<td>Introduction to Classical Physics</td>
<td>Phys. 221</td>
<td>5</td>
</tr>
<tr>
<td>Electives</td>
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<tr>
<td><strong>Total</strong></td>
<td>16</td>
<td></td>
</tr>
<tr>
<td><strong>Junior Year</strong></td>
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<td></td>
</tr>
<tr>
<td>Physical Chemistry</td>
<td>Chem. 325, 327A</td>
<td>6</td>
</tr>
<tr>
<td>Foreign Language</td>
<td>F. L. 121 or 131</td>
<td>4</td>
</tr>
<tr>
<td>Electives</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>16</td>
<td></td>
</tr>
<tr>
<td><strong>Senior Year</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Electives</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>16</td>
<td>15</td>
</tr>
</tbody>
</table>

Of the 81 elective credits, at least 24 must be in advanced chemistry, biochemistry, biophysics, physics, mathematics, computer science, biological science, or engineering. Of these 24 credits, 6 must be advanced chemistry or advanced biochemistry and should be in lecture courses. Of the remaining 57 credits, 9 must be in biological science; 9 must be in history, literature, philosophy, or advanced English composition; and at least 9 must be in economics, industrial administration, sociology, psychology, or political science. Thirty credits are not specified.

### Curriculum in Music

This curriculum leads to the degree Bachelor of Music and is an alternative to the curriculum in sciences and humanities with a major in music. At least 192 credits, in accordance with the requirements specified below, must be earned for graduation.

**General Education Requirements.** (Students choosing the music education option will meet the general education requirements of the College of Education.)

- English 104, 105 ................................................................. 8 credits
- Speech 211 ................................................................. 3 credits
- Additional English or speech ........................................ 3 credits
- Mathematical, physical, and biological sciences (present groups 2 and/or 3 and/or 4) ........................................ 15 credits
- Social science (anthropology, economics, political science, psychology, sociology) ........................................ 6 credits
- History 201, 202, 203 (Western Civilization) ................ 9 credits
- Foreign language ................................................................ 12 credits
- Music 355, 356, 357 (History of Music) ........................... 9 credits
- Electives (nonmusic courses) ........................................ 6-10 credits

**Library and Physical Education** .............................................. 4 credits
<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Music Core</td>
<td>71-73</td>
</tr>
<tr>
<td>Music 104, 201, 202, 203, 304, 305, 306, 361</td>
<td>29</td>
</tr>
<tr>
<td>Music 119, 219, 319, 419</td>
<td>20</td>
</tr>
<tr>
<td>Two of the following: Music 371, 373, 375, 376, 377, 380, 382, 490D</td>
<td>18</td>
</tr>
<tr>
<td>Three 3-credit courses in Music 490B, 490C</td>
<td>9</td>
</tr>
<tr>
<td>Ensembles</td>
<td>11</td>
</tr>
</tbody>
</table>

**Music Major—Select one of the following options**

**A. History and Literature**

- Music 380, 382, 490D (American Music)                              | 8 credits |
- Additional foreign language                                       | 12 credits |
- Electives                                                         | 26 credits |

**B. Music education—vocal**

- Professional education requirement (satisfies secondary certification requirement): Edu 204, 305A, 305B, 426, Psych 230, 333. | 16 credits |
- Additional professional education for K-12 certification: C.D. 236, 337, 460; El Ed. 344 | 12 credits |
- Student teaching                                                  | 9-16 credits |
- Secondary certification                                           | 9 credits |
- K-12 certification                                                | 16 credits |
- Music 310, 362A, 366, 465A                                        | 11 credits |
- Additional applied music                                          | 6 credits |
- Electives (for secondary certification only)                      | 4 credits |

**C. Music education—instrumental**

- Professional education requirement (satisfies secondary certification requirement): Edu 204, 305A, 305B, 426, Psych 230, 333. | 16 credits |
- Additional professional education for K-12 certification: C.D. 236, 337, 460; El Ed. 344 | 12 credits |
- Student teaching                                                  | 9-16 credits |
- Secondary certification                                           | 9 credits |
- K-12 certification                                                | 16 credits |
- Music 119, 362B, 366, 465B                                        | 10 credits |
- Music 357, 368 or 369                                            | 4 credits |
- Music 457, 468, 469                                              | 6 credits |
- Electives                                                         | 0-1 credit |

**D. Organ**

- Music 119B, 219B                                                 | 6 credits |
- Music 319C, 419C                                                | 6 credits |
- Music 376, 382, 480, 490F (Materials and Methods of Organ Teaching), 490F (History of Design and Construction of the Organ) | 13 credits |
- Electives                                                        | 22 credits |

**E. Piano**

- Music 319B, 419B                                                 | 18 credits |
- Music 480, 490F (Master Class in Accompanying and Sight Reading), 490F (Pedagogy and Philosophy of Teaching), 490E (Keyboard Literature) | 20 credits |
- Electives                                                        | 8 credits |

**F. String instruments**

- Music 119D, 219D, 319D, 419D                                      | 18 credits |
- Music 181, 321B, 480                                            | 9 credits |
- Electives                                                        | 19 credits |
### Curriculum in Physical Education for Men

This curriculum leads to either the degree Bachelor of Arts or Bachelor of Science and is an alternative to the curriculum in sciences and humanities with a major in physical education for men.

One unit of high school algebra is required for admission into this curriculum.

At least 192 credits, including 6 credits from the basic instruction program in physical education (P.E.M. 101 and 5 credits in courses numbered 111 through 158) and 1 credit of library instruction, must be earned in accordance with the following requirements for graduation.

<table>
<thead>
<tr>
<th>FALL QUARTER</th>
<th>WINTER QUARTER</th>
<th>SPRING QUARTER</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Language in Composition and Reading</strong></td>
<td><strong>Language in Composition and Reading</strong></td>
<td><strong>Foundations of American Education</strong></td>
</tr>
<tr>
<td>Engl. 104</td>
<td>Engl. 105</td>
<td>Educ. 2041</td>
</tr>
<tr>
<td>4</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td><strong>Personal Health Education</strong></td>
<td><strong>Introduction to Sociology</strong></td>
<td><strong>General Psychology</strong></td>
</tr>
<tr>
<td>Hyg. 104</td>
<td>Soc. 134</td>
<td>Psych. 101</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td><strong>Introduction to Physical Education</strong></td>
<td><strong>Elementary Human Physiology and Anatomy</strong></td>
<td><strong>Library Science</strong></td>
</tr>
<tr>
<td>P.E.M. 200</td>
<td>Zool. 155</td>
<td>Lib. 160</td>
</tr>
<tr>
<td>3</td>
<td>5</td>
<td>1</td>
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<tr>
<td><strong>Introduction to Recreation</strong></td>
<td><strong>Physical Education</strong></td>
<td><strong>Physical Education</strong></td>
</tr>
<tr>
<td>P.E.M. 201</td>
<td>P.E.M.</td>
<td>P.E.M.</td>
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<tr>
<td>3</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td><strong>Foundations of Physical Education</strong></td>
<td><strong>Elective</strong></td>
<td><strong>Elective</strong></td>
</tr>
<tr>
<td>P.E.M. 101</td>
<td>(Chemistry, geology, mathematics, physics)</td>
<td>(Chemistry, geology, mathematics, physics)</td>
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<tr>
<td>1</td>
<td>3-4</td>
<td>3-4</td>
</tr>
<tr>
<td><strong>Elective</strong></td>
<td></td>
<td><strong>Elective</strong></td>
</tr>
<tr>
<td>(Chemistry, geology, mathematics, physics)</td>
<td></td>
<td>(History, literature, philosophy)</td>
</tr>
<tr>
<td>3-4</td>
<td></td>
<td>3-4</td>
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<tr>
<td><strong>Total:</strong> 17-18</td>
<td><strong>Total:</strong> 16-17</td>
<td><strong>Total:</strong> 14-16</td>
</tr>
</tbody>
</table>

1For recreation option, substitute Soc. 202.

The student will, with the aid of his adviser, submit a degree program for the approval of the department head and the dean of the College of Sciences and Humanities not later than four quarters before graduation.

Such a degree program shall include:

1. A minimum of 75 credits distributed in the following general education groups:
   a. Written and spoken English (including Sp. 211) ................................................................. 14-21 credits
   b. Mathematics and physical sciences .................................................................................. 9-21 credits
c. Biological sciences........................................... ................................................................. 9-21 credits

d. Social sciences (including Pol.S. 215)................................................................................... 9-21 credits

e. Humanities.......................................................................................................................... 9-21 credits

2. The requirements of one of the following programs

Teaching Certification

a. Completion of the professional education requirement.
  See Index, College of Education.

b. Hyg. 104, 105, 304 .................................................................................................................. 7 credits

c. Zool. 155, 359......................................................................................................................... 10 credits

d. Physical education professional courses .............................................................................. 46 credits minimum
   (Not more than 60 credits may apply toward the 192 credits required for graduation.)

e. Teacher certification in one restricted area (30 credits) in addition to physical education
   is possible but not required. See Index, College of Education. Select from applied art,
   biology, chemistry, earth science, English, foreign language, general science, history,
   political science, industrial education, mathematics, physics, safety and driver education,
   social studies, or speech.

General Physical Education

a. Hyg. 104, 105.......................................................................................................................... 4 credits

b. Physical education professional courses .............................................................................. 30 credits minimum
   (Not more than 60 credits may apply toward the 192 credits required for graduation.)

   This satisfies the major requirement.

c. One minor of at least 21 credits, or two minors having at least 12 credits each and totaling at least
   27 credits. (Minors may be chosen from the list of major fields listed in the College of
   Sciences and Humanities or from the fields of genetics, Air Force aerospace studies,
   military science, or from major fields offered in other colleges. A minor may
   include courses from two or more closely related fields if they form a strong
   and coherent program directed toward a definite educational objective.)

Recreation Education

a. Hygiene........................................................................................................................................ 3 credits

b. Industrial administration ........................................................................................................... 10 credits

c. Landscape architecture and urban planning ............................................................................ 9 credits

d. Physical education professional courses .............................................................................. 30 credits minimum
   (Not more than 60 credits may apply toward the 192 credits required for graduation.)
   (1) Recreation (22 cr.)
   (2) P.E.W. dance courses (4 cr.)

e. Sociology .................................................................................................................................. 18 credits minimum

f. Area of specialization.............................................................................................................. 15 credits minimum
   Select from art, drama, fisheries and wildlife biology, forestry, industrial
   administration, landscape architecture, music, speech, or urban planning.
The Iowa State University College of Veterinary Medicine was established in 1879 and is now the oldest school of veterinary medicine in the United States. It includes the departments of Anatomy, Microbiology and Preventive Medicine, Clinical Sciences, Pathology, and Physiology and Pharmacology. Instruction in biochemistry, nutrition, and other related sciences is provided by other colleges of the University. In addition to the teaching departments, the Veterinary Medical Research Institute, the Biomedical Engineering Program, and the Veterinary Medical Diagnostic Laboratory give the student opportunity to observe phases of veterinary medicine for which these disciplines are responsible.

The location of the college in the center of the richest livestock country in the world provides a rare opportunity for the veterinary student to study animal industry. It also enables him to observe a wealth of clinical cases both at the hospital clinic and under general practice conditions through the ambulatory clinic.

A minimum of two years of prescribed preprofessional college work, with a creditable academic average, is required for admission to the professional curriculum in veterinary medicine. Students who wish to receive both the degrees Doctor of Veterinary Medicine and Bachelor of Science take at least three years' work in the curricula in agriculture or sciences and humanities. Such a program must have the approval of the deans of agriculture or sciences and humanities and veterinary medicine. The professional curriculum extends over a period of four years and leads to the degree Doctor of Veterinary Medicine.

To be awarded the degree Doctor of Veterinary Medicine, candidates must be 21 years of age and of good moral and professional character, have passed all courses in the veterinary curriculum, have at least two quality points per credit in all courses taken in the professional curriculum, and be approved by all departments of the college.

OPPORTUNITIES IN VETERINARY MEDICINE FOR THE GRADUATE

The veterinary medical profession, which for many years focused its attention largely on farm animals, has developed to the point where it is vitally concerned with the health and well-being of all animals. It has joined with the profession of human medicine in protecting the health of all species.

With the increased responsibilities of the profession have come increased opportunities.

Private Practice

The importance of the livestock industry in the United States, and the manner in which agri-business is now conducted assure the veterinarian an opportunity to establish a successful private practice. In recent years there has been a tendency for some to specialize along species lines and to devote their attention mainly to large animals or small animals. Others prefer to specialize along disciplinary lines such as obstetrics or surgery. Many veterinarians now maintain private hospitals adequately equipped for the diagnosis and treatment of diseases of pets, and devote their practice entirely to this field. Associations of specialists are being formed.

The Agricultural Research Service

The Agricultural Research Service of the United States Department of Agriculture employs more veterinarians than any other agency, utilizing many hundreds in its widespread activities. These include federal meat inspection, animal quarantine, control and eradication of preventable animal diseases, supervision of the production of biological products, and an extensive program of animal disease research.
Education and Research

Advanced degrees usually are necessary for the greatest progress in teaching and research positions at veterinary medical, medical, and agricultural colleges. Because the number of veterinary colleges is increasing, and because veterinary student enrollments are larger, opportunities to join the faculties of these colleges are especially good at the present time. Research veterinarians may be attached to state agricultural experiment stations or the Agricultural Research Service of the USDA.

Industry

Veterinarians are employed extensively by commercial concerns engaged in the production of biological and pharmaceutical products used in the control and treatment of both animal and human diseases. Such positions may require special training and include technical laboratory and field work.

Public Health Service

Federal, state, and local governments employ veterinarians as integral parts of the public health team. The Communicable Disease Center of the United States Public Health Service may assign veterinarians to a section of the nation where special disease problems exist. Municipalities employ veterinarians to inspect, control, and insure the quality of food supplies, especially meat and milk, and to prevent and control animal diseases which are transmissible to man. In some states the Department of Health uses veterinarians in the field of epidemiology and health education. They are also employed by the Pan-American Sanitary Bureau and the World Health Organization.

Veterinary Corps, United States Army and United States Air Force

Students in veterinary medicine are usually deferred by Selective Service Boards in order to complete their professional education. Upon graduation some are required to serve two years in the Army or Air Force. Upon entering the service, the graduate is commissioned as a captain. The Veterinary Corps assures that food products, especially those of animal origin, are wholesome and suitable for members of the Armed Forces. Other responsibilities are the protection of animals and birds essential to war activities, work with environmental health units where knowledge of diseases transmissible to man, training in laboratory techniques, and knowledge of parasitic diseases are important.

State Governments

Every state has a state veterinarian or similar officer, often with a number of assistants, whose duties are to investigate and control diseases of animals by enforcing state laws and regulations.

Laboratory Animal Medicine

This specialty includes all of the veterinary medical aspects of the common laboratory animal species. The laboratory animal veterinarian provides certain essential professional services for biomedical research institutes, laboratories, hospitals, and medical schools, and serves as a key member of aerospace and bioastronautical research teams.

Other Fields of Service

Many other interests also employ veterinarians. Among these are hospitals, artificial breeding organizations, zoological societies, livestock ranches, humane societies, and the fur industry.
VETERINARY MEDICAL SOCIETIES

All veterinary students are members of the Iowa State Student Chapter of the American Veterinary Medical Association. The monthly meetings of the society, devoted to discussions of professional topics, serve to promote the literary and social development of the members.

Students of veterinary medicine also may qualify for membership in the national honor societies Phi Zeta, Phi Kappa Phi, Alpha Zeta, and Gamma Sigma Delta. Graduate students are eligible for membership in Sigma XI.

HONORS PROGRAM

Students with high ability and a desire to initiate independent study are encouraged to participate in the College of Veterinary Medicine Honors Program. See Honors Program.

ADMISSION REQUIREMENTS

Applicants for admission to the College of Veterinary Medicine must present a total of not less than 90 quarter (60 semester) credits, excluding physical education credits, from an approved college or university. Credits, for those seeking admission to the professional curriculum in 1973 or subsequent years, must include the following:

<table>
<thead>
<tr>
<th>Subject</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>English (Engl. 104, 105)</td>
<td>8 qr. cr. (6 sem. cr.)</td>
</tr>
<tr>
<td>Speech (Sp. 211)</td>
<td>3 qr. cr. (2 sem. cr.)</td>
</tr>
<tr>
<td>Library (Lib. 160)</td>
<td>1 qr. cr. (1 sem. cr.)</td>
</tr>
<tr>
<td>Chemistry</td>
<td>21 qr. cr. (14 sem. cr.)</td>
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<tr>
<td>General (Chem. 141, 141L, 142, 142L)</td>
<td>(8 cr.)</td>
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<tr>
<td>Quantitative (Chem. 211)</td>
<td>5 cr.</td>
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<tr>
<td>Organic (Chem. 334, 335, 337)</td>
<td>(8 cr)</td>
</tr>
<tr>
<td>Mathematics (Math. 104 or 109)</td>
<td>5 qr. cr. (3 sem. cr.)</td>
</tr>
<tr>
<td>Physics (Phys. 111, 112, 113)</td>
<td>12 qr. cr. (8 sem. cr.)</td>
</tr>
<tr>
<td>Biological Sciences</td>
<td>13 qr. cr. (8 sem. cr.)</td>
</tr>
<tr>
<td>Biology (Biol. 101, 101A)</td>
<td>5 cr.</td>
</tr>
<tr>
<td>Zoology (Zool. 106)</td>
<td>5 cr.</td>
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<tr>
<td>Genetics (Gen. 350)</td>
<td>3 cr.</td>
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<tr>
<td>Animal Science (An.S. 114)</td>
<td>5 qr. cr. (3 sem. cr.)</td>
</tr>
<tr>
<td>American Government (Pol.S. 215)</td>
<td>3 qr. cr. (2 sem. cr.)</td>
</tr>
<tr>
<td>Electives</td>
<td>19 qr. cr. (13 sem. cr.)</td>
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</table>

Preprofessional students at Iowa State University enroll in either the College of Agriculture or the College of Sciences and Humanities. A preveterinary student at Iowa State University may elect a 3-year preveterinary program which when combined with the veterinary curriculum will lead to the degree Bachelor of Science in the College of Agriculture or in the College of Sciences and Humanities.

All preveterinary students must have completed at least 45 quarter (30 semester) credits prior to filing an application for admission to the College of Veterinary Medicine. Applications must be filed with the director of admissions (Room 104 Beardshear Hall) prior to January 15 of the year in which the applicant seeks admission. A transcript of all high school and college credits must accompany the application. All preveterinary requirements must be fulfilled by the time of filing or scheduled for completion by June 15 of the year in which the applicant seeks admission. A list of courses in progress at the time of filing or scheduled for completion by June 15 should accompany the application and transcript. Preprofessional college credits must average at least 2.25 on a four-letter marking system with "A" as the highest mark (4.0) and "D" as the lowest mark (1.0). The preceding scholastic requirements are minimum and do not assure admission even though these requirements have been fulfilled.

Because of limited facilities, admission to the College of Veterinary Medicine is on a competitive and selective basis. A preadmission conference with members of the veterinary faculty or other persons designated by the dean is required. High school records, scholastic performance in preprofessional courses, aptitude, character, and personality are given special consideration in the selection of candidates. Other qualifications being equal, residents of the state of Iowa are given preference.

Admission to the College of Veterinary Medicine is granted annually at the beginning of the fall quarter only.
# Curriculum in Veterinary Medicine

Leading to the degree Doctor of Veterinary Medicine.

<table>
<thead>
<tr>
<th>FALL QUARTER</th>
<th>WINTER QUARTER</th>
<th>SPRING QUARTER</th>
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<tr>
<td><strong>Credits</strong></td>
<td><strong>Credits</strong></td>
<td><strong>Credits</strong></td>
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<td>Physiological Chemistry</td>
<td>Comparative Mammalian Physiology</td>
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<tr>
<td>B.&amp;B. 304</td>
<td>B.&amp;B. 305</td>
<td>V.Phy. 316</td>
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<tr>
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<td>Professional Orientation</td>
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<td>V.M. 300</td>
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| **Second Year** |                |                |
| Pharmacology and Therapeutic Principles | Pharmacology | Systemic Pathology |
| V.Phy. 367 | V.Phy. 368 | V.Pth. 372 |
| 5 | 6 | 6 |
| General Bacteriology and Immunology | Pathogenic Bacteriology | General Surgery |
| V.Micr. 381 | V.Micr. 382 | V.C.S. 397 |
| 6 | 6 | 5 |
| Animal Nutrition I | Animal Nutrition II | Virology and Principles of Epidemiology |
| An.S. 419 | An.S. 419 | V.Micr. 383 |
| 3 | 3 | 5 |
| General Pathology | Veterinary Parasitology | Veterinary Parasitology |
| V.Pth. 371 | V.Pth. 376 | V.Pth. 377 |
| 5 | 4 | 5 |
| 19 | 19 | 21 |

| **Third Year** | | |
| Special Surgery I | Special Surgery II | Radiology |
| V.C.S. 441 | V.C.S. 442 | V.C.S. 440 |
| 3 | 5 | 3 |
| Applied Anatomy | Clinical Medicine II | Clinical Medicine III |
| V.An. 406 | V.C.S. 445 | V.C.S. 446 |
| 3 | 5 | 5 |
| Clinical Medicine I | Infectious Diseases | Infectious Diseases |
| V.C.S. 444 | V.Micr. 432 | V.Micr. 433 |
| 6 | 3 | 3 |
| Infectious Diseases | Special Pathology | Special Pathology |
| V.Micr. 431 | V.Pth. 422 | V.Pth. 423 |
| 3 | 6 | 3 |
| Disturbances of Reproduction | Medicine Laboratory | Surgery Laboratory |
| V.C.S. 450 | V.C.S. 448 | V.C.S. 449 |
| 4 | 1 | 3 |
| Animal Reproduction Laboratory | | Veterinary Toxicology and Poisonous Plants |
| V.C.S. 447 | | V.Pth. 456 |
| 1 | | 5 |
| | | 22 |
First or Second Summer Session

Summer Clinics  
V.C.S. 491

**Fourth Year**

<table>
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<tr>
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<tr>
<td>Public Health I</td>
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<td>V.Micr. 484</td>
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<tr>
<td>Public Health II</td>
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<table>
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<tr>
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<tr>
<td>Professional Orientation and Jurisprudence</td>
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</tr>
<tr>
<td>V.M. 498</td>
<td>18</td>
</tr>
</tbody>
</table>

1\(^{1}\) Taught by all veterinary departments.

**READEMISSION**

Any student who voluntarily withdraws from the College of Veterinary Medicine or who is dropped for cause, forfeits his standing and must make written application for reinstatement to this college 30 or more days prior to the opening of the quarter in which the student desires readmission.
Iowa State University has offered opportunities for graduate work to qualified students since the founding of the institution. The first advanced degree was conferred in 1877. In early years, the work of graduate students was in immediate charge of the departments concerned, under the supervision of the general faculty. Later, each of the faculties of the colleges of Agriculture, Engineering, Home Economics, Science, and Veterinary Medicine assumed control of graduate work. In 1913, a distinct graduate faculty was organized, and an executive graduate committee was appointed. In 1915, the graduate faculty held its first meeting, and in 1916 it granted the first degree Doctor of Philosophy.

The graduate faculty consists of the president, the dean of the Graduate College, the vice president for academic affairs, deans of the six colleges, the director of the library, the dean of admissions and records, heads of departments offering graduate work, and members of the faculty who are elected to membership in recognition of accomplishments in their respective disciplines.

The Graduate College administers advanced study and degree programs in most fields of study offered by the University. Most of the graduate programs offered are research-oriented and lead to the degrees Master of Science and Doctor of Philosophy. In certain fields the degree Master of Arts and the degree Master of Science without thesis are also available.

For those persons interested in advanced study directed more particularly toward meeting vocational or professional objectives, the degrees Master of Architecture, Master of Education, Master of Engineering, Master of Forestry, and Master of Landscape Architecture are offered.

GRADUATE APPOINTMENTS

Graduate assistantships, industrial fellowships, and certain special research grants have been established at Iowa State University for the encouragement of graduate work and the promotion of research. Such appointments and research opportunities are available through the various departments of instruction, the Agriculture and Home Economics Experiment Station, the Engineering Research Institute, the Home Economics Research Institute, the Sciences and Humanities Research Institute, the Statistical Laboratory, the Computation Center, the Institute for Atomic Research, and the Veterinary Medical Research Institute.

Graduate assistantships permit the holder to enroll for two-thirds of a full schedule, or 11 credits per quarter. Recipients of these assistantships are exempt from payment of other fees except for $120 per quarter. A graduate assistant is expected to give half-time service to the teaching or research projects of his department. These appointments are open to students who have graduated from approved colleges in the highest quartile of their respective classes and who present the requisite undergraduate or graduate preparation. Further information may be obtained by writing to the department head concerned or to the dean of the Graduate College.

Fellowships and training grants supported by the National Science Foundation, the Public Health Service, the National Aeronautics and Space Administration, the United States Office of Education, and other agencies of the federal government are offered. University-supported fellowships also are available. Applicants for these awards must present evidence of superior scholarship. Further information may be secured by writing to the dean of the Graduate College.

The satisfactory completion of one appointment will ordinarily make a student eligible for reappointment.
POST DOCTORAL STUDY

Opportunities are provided for postdoctoral study through the extensive research programs of the University. Inquiries should be directed to the appropriate institute or to the dean of the Graduate College.

GRADUATE STUDY BY MEMBERS OF THE STAFF

Any member of the research, instructional, or extension staffs of the rank of instructor, associate, or junior scientist, subject to the approval of the head of his department or section, may carry not more than 5 credits of graduate work per quarter, provided such does not interfere with his other duties. This privilege may be extended to members of the research, instructional, or extension staffs of the rank of assistant professor upon approval of the college dean concerned and the dean of the Graduate College.

Staff members holding the rank of professor or associate professor cannot become candidates for degrees from this institution.

ADMISSION

A prospective student is invited to correspond with the head of the department in which he wishes to study for information concerning graduate study in that academic discipline.

Application blanks are available from the Office of Admissions, 7 Beardshear Hall. These blanks, together with official transcripts and statement of quartile rank, should be forwarded to the Office of Admissions at least one month prior to the opening of the quarter when the student wishes to matriculate. An application fee of $10 is charged each applicant formally applying for admission to the Graduate College.

Unrestricted Admission. An applicant who is a graduate of an institution in the United States whose requirements for the bachelor's degree are substantially equivalent to those at Iowa State University, and who ranks in the upper one-half of his class, may be admitted to the Graduate College, if recommended by the department head and approved by the dean of the Graduate College. Admission does not constitute acceptance as a candidate for a degree.

Admission to the Graduate College may not be granted to a graduate of an institution in the United States which is not accredited by a recognized regional association.

Restricted Admission. An applicant who is a graduate of an accredited university in the United States, but who does not rank in the upper one-half of his class, may be granted restricted admission if such consideration seems justified. This will require the recommendation by the department head and approval by the graduate dean.

Transfer from restricted admission to unrestricted admission requires recommendation of the major professor and approval by the graduate dean.

Graduates of recognized universities located outside the United States may be granted restricted admission only.

Medical Examination. Upon entering Iowa State University, each graduate student is required to have a physical examination which must include a tuberculin test and/or chest x-ray taken within the past year. Students accepted for admission will be sent forms to be completed by a personal physician who should return them promptly to the University Hospital. Registration will not be permitted until this requirement has been met.

Foreign students are required to carry adequate health and accident insurance while in residence.

Graduate Record Examination. No uniform examination is currently required of all applicants for admission.

English Requirement. All graduate students, except those who have met the requirement as undergraduates at Iowa State University within the last two years and graduate students admitted on a nondegree basis are required to pass a qualifying examination in English. It is expected that this requirement will be met during the first quarter or summer term of residence.

Foreign students take a special examination which is administered by the Department of English in cooperation with the Office of Foreign Student and Visitor Services.
REGISTRATION

Planning Graduate Study. Scholastic competence, independence and maturity of thought should have dominance over other objectives of graduate study. The student must accept responsibility for his own education and should recognize that excessive emphasis on course work will not leave time to explore and master aspects of learning which will give him confidence in his own judgments. As soon as possible, in conference with the head of his department, the student should select his major professor and advisory committee and in consultation with them outline his program of study.

Residence Registration. Classification in courses carrying full graduate credit is limited to a maximum of 15 credits per quarter. The maximum, if part of the work is supporting (not for graduate credit), is 16 credits. Schedules for graduate assistants are limited to a maximum of 11 credits; for full-time staff members, to 5 credits.

Graduate students (even though course and residence requirements have been met) must register in any quarter in which the facilities of the institution or staff time are being used in preparation of thesis or in preparation for examination. The number of credits under these circumstances shall be consonant with the amount of work done, laboratory facilities used, and staff direction involved.

Interim Registration. Registration for special work between quarters and during certain vacation periods cannot exceed 1 credit for each week that the student is in residence. The fee is $29 per credit for residents and $50 per credit for nonresidents.

"In Absentia" Registration. Graduate work by correspondence is not permitted, nor is it accepted in transfer. In exceptional cases, the Graduate Committee may authorize registration in absentia. Generally such registration is restricted to thesis preparation after completion of research or for research under special conditions. The total credit thus obtained cannot be used to reduce residence requirements.

Extension and Off-campus Registration. Classes away from the campus in some areas of engineering and education are taught by members of the University graduate staff. Only limited credit earned in such classes can be applied toward a graduate degree. Such courses cannot be used to meet the residence requirement.

Auditing. Courses may be audited upon recommendation of the student's major professor. Each audited course will reduce the permitted credit load by one, but fees will be assessed on the basis of catalog credit.

Graduate Credit for Seniors. Under special circumstances, a department head may request from the graduate dean permission to classify a senior student in certain graduate courses if he is within 6 credits of fulfilling requirements for the bachelor's degree. Then, after the student has received his bachelor's degree and has been registered in the Graduate College, the chairman of his graduate committee may request by letter that the credits so received be applied toward an advanced degree.

Special Regulations for Students in Veterinary Medicine. Specially qualified graduates in scientific curricula, when the request has been approved by the dean of Veterinary Medicine and the dean of the Graduate College, may pursue work coincidentally toward the degrees Master of Science and Doctor of Veterinary Medicine. The major graduate work of such students must be completed in courses not required in the undergraduate curriculum in Veterinary Medicine. A student taking advantage of this opportunity will classify with both the dean of Veterinary Medicine and the dean of the Graduate College.

DEGREE REQUIREMENTS

A Guide to Graduate College Procedures is available in the Office of the Graduate Dean, 222 Beardshear Hall. Each new graduate student is urged to secure a copy.

Probation. Students must maintain an average of "B" on all work taken in the Graduate College to remain in good standing. The graduate committee may place a student on probation for failure to meet scholastic or other requirements. Removal from probation is accomplished upon specific recommendation from the student's major professor to the graduate committee. Students will not be admitted to candidacy while on probation. Generally registration
beyond the third quarter will be refused to a student whose quality of work is unsatisfactory.

Time Limit. It is expected that work for the master's degree shall be completed within a term of three years or five summer quarters; for the doctorate, work shall be completed within a term of five years. Only in exceptional cases, upon recommendation of a student's advisory committee and with approval by the graduate committee, is credit allowed for courses taken over a period of more than five years.

Master of Science and Master of Arts

A student becomes eligible for candidacy after completing one quarter's work with a "B" average. General requirements for the degree are as follows:

Appointment of the Student's Advisory Committee. Following enrollment in the Graduate College and as soon as practicable thereafter, the department head shall recommend to the dean of the Graduate College, a committee of the graduate faculty to be in charge of the student's work. This committee shall consist of at least three members of the graduate faculty, one of whom must come from a different department. An associate member of the graduate faculty may serve as major professor for a master's degree candidate.

Program of Study. A program of study should be developed in consultation with the student's committee. This should be submitted for approval by the end of the second quarter in residence.

Residence. Three quarters, or a minimum of 30 weeks of full-time graduate study, must be spent in residence at Iowa State University. In some programs, arrangements have been made whereby residence credit earned at specific sister institutions may be accepted as residence credit on this campus.

Credits. At least 45 credits of acceptable graduate work must be completed, not less than 36 of which must be taken in this institution.

Any transfer of credits from another institution must be recommended in the program of study by the student's advisory committee. Transfer of graduate credit will be approved only if it is of "B" grade or better.

Major and Minor. The exact number of credits in major and minor fields is not prescribed. To obtain the specialization which is considered essential for an advanced degree, approximately two-thirds of the work should be devoted to the major field, but this is not necessarily restricted to one department.

A graduate student may not change from one major to another without written permission from the heads of both departments and the dean of the Graduate College.

Foreign Languages. There is no uniform requirement for the Graduate College. Please see the departmental descriptions in this catalog for details.

For those departments wishing to utilize them and for students interested in transferring a foreign language test score elsewhere, the University offers the standardized examinations provided by Educational Testing Service.

For students whose native language is not English, the ability to communicate adequately in English (certified by the Department of English) may be acceptable as a substitution for the reading knowledge of one foreign language. This option will apply only when specifically recommended by the student's advisory committee.

The foreign language requirement, where applicable, may not be met in the quarter in which the student will receive his degree.

Application for Graduation. Application for graduation must be made by midterm of the quarter preceding the quarter in which the student expects to receive the degree. This requires the presentation of an approved diploma slip to the Office of the Graduate Dean.

Thesis. A thesis is required in all areas in which the M.S. or M.A. is granted, except where specific provision is made for a non-thesis degree program. Joint authorship is not permitted. Copies of the completed thesis must be in the hands of the examining committee and the Thesis Office for approval two weeks prior to the date fixed for the final examination. After the final examination, two unbound approved copies of the thesis shall be deposited...
with the Thesis Office, University Library. These copies of the thesis must be deposited not less than two weeks prior to commencement. A charge of $25 will be made to cover library costs and title publication in the Iowa State Journal of Science.

The student should consult The Graduate College Thesis Manual, prepared for the use of students in the Graduate College, before arranging for the typing of his thesis.

Final Examination. After all other requirements have been met, the final examination shall be taken on all graduate work, including the thesis where applicable. It will ordinarily be oral, but may be written in whole or in part, as determined by the committee in charge.

Graduation Approval Slip. These slips are prepared by the Office of Student Records about two weeks prior to the end of a quarter. Candidates wishing to secure this form at any earlier date should file a request with the Office of the Graduate Dean at least three days prior to the time the form is needed.

Master of Science and Master of Arts—Nonthesis

In certain authorized departments where research specialization does not best meet the professional needs of the student, a nonthesis degree program may be undertaken. This will require satisfactory completion of at least 45 quarter hours of acceptable credits (not including research credit) and satisfactory completion of a comprehensive examination. Detailed requirements may vary with fields. Reference should be made to the departmental descriptions in this catalog.

Master of Architecture

For the degree Master of Architecture, a minimum of 90 credits beyond the degree Bachelor of Arts or 45 credits beyond the degree Bachelor of Architecture is required.

Master of Education

For the degree Master of Education, a minimum of 52 credits will be required, provided all credits are in graduate level courses. A minimum of 15 credits must be earned in course work outside the major. No foreign language is required. A field study is written in lieu of a thesis.
Master of Engineering

The academic standards and the general level of attainment are the same for the Master of Engineering and Master of Science degrees. Master of Engineering programs are intended to be more flexible in their educational objectives, and they are offered to meet the expanding needs for off-campus graduate engineering programs at locations with adequate library and laboratory facilities, and for special situations of professionally oriented programs on campus.

General requirements for the degree Master of Engineering are the same as those for the degree Master of Science. No foreign language is required. Upon recommendation of the student's committee, the thesis requirement may be waived. Choice of this option requires the completion of an additional 7 credits of acceptable graduate work.

Of the minimum credit requirement of 45, 36 credits must be received from Iowa State University. At least 12 credits must be earned in residence at Iowa State University during one quarter or two summer terms, not necessarily consecutive sessions.

Master of Forestry

The degree Master of Forestry is designed to provide advanced educational opportunities for the student with objectives that require graduate study, but who intends to enter the forestry profession as a practitioner rather than as a researcher or teacher. Primary emphasis is on professional development on a broad plane for an administrative career but with freedom for some concentration within this framework.

The Master of Forestry degree is a nonthesis program which calls for completion of 52 credits of acceptable graduate work of which at least 35 credits must be at the 500- or 600-level. Thirty-six credits are required in residence at Iowa State University. The foreign language requirement may be waived upon the recommendation of the department head.

Master of Landscape Architecture

General requirements are the same as those for the degree Master of Science with the exception that a student has the option of presenting a terminal problem in lieu of a thesis. The foreign language requirement may be waived upon recommendation of the department head.

Doctor of Philosophy

The degree Doctor of Philosophy is strongly research oriented. The primary requirements for the degree are: (1) high attainment and proficiency of the candidate in his chosen field, (2) development of a dissertation which shall be a significant contribution to knowledge and which shall show power of independent and creative thought and work, and (3) successful passing of detailed examinations over the field of the candidate's major work, with a satisfactory showing of his preparation in related and minor courses.

Appointment of the Student's Advisory Committee. Following enrollment in the Graduate College, and as soon as practicable thereafter, the department head shall recommend to the dean of the Graduate College a committee of the graduate faculty to be in charge of the student's graduate program. This committee shall consist of the following: at least five members of the graduate faculty—two of whom must come from outside the major discipline, with one of these from a different department. An associate member of the graduate faculty may not serve as major professor of a doctoral program.

Program of Study. A program of study should be developed in consultation with the student's committee. This should be submitted for approval by the end of the third quarter in residence.

Residence. A minimum of three years shall be spent in full-time graduate study, at least half of which is to be in residence at Iowa State University. At least three quarters of resident study must be during the academic year. To satisfy any one-year residence requirement, at least 36 credits must be earned. Any transfer of graduate credit from another institution must be recommended in the program of study by the student's advisory committee. Transfer of graduate credit will be approved only if it is of "B" grade or better.
Major and Minor. To avoid overspecialization, a significant body of pertinent course work must be taken outside of the major field. The work outside the major field should amount to approximately 18 hours of applicable graduate credit as required by the student's committee.

The major field is equivalent to the major department except for: (1) established interdisciplinary majors and (2) majors within departments which may be approved by the graduate committee.

Foreign Languages. There are no uniform requirements for the Graduate College. Please see the departmental descriptions in this catalog for details.

For those departments wishing to use them and for students interested in transferring a foreign language test score elsewhere, the University offers the standardized examinations provided by the Educational Testing Service.

For students whose native language is not English, the ability to communicate adequately in English (certified by the Department of English) may be acceptable as a substitution for the reading knowledge of one foreign language. This option will apply only when specifically recommended by the student's advisory committee.

The foreign language requirement, where applicable, must be met before the preliminary examination is held.

Preliminary Examination. The student must pass satisfactorily a preliminary examination before he is granted advancement to candidacy for the degree. The examination is usually both written and oral, unless otherwise specifically recommended by the committee. The preliminary examination must be passed at least three quarters before the final examination. Exceptions to this rule will be made only upon special recommendation of the student's committee and approval of the graduate committee. In no case may the final examination be given less than six months from the time of the preliminary examination.

Diploma Slip. A diploma slip must be filled out and returned by midterm of the quarter preceding the quarter in which the student expects to receive the degree.

Dissertation. A doctoral dissertation shall be completed on some topic connected with the major subject. To be acceptable it must constitute a significant contribution to knowledge. Joint authorship is not permitted.

Copies of the completed dissertation must be in the hands of the examining committee and the Thesis Office for approval two weeks prior to the date fixed for the final examination. After the examination, and at least two weeks prior to commencement, two complete and approved copies of the dissertation shall be deposited with the Thesis Office, University Library.

At the same time the dissertation is deposited, two typewritten copies of an abstract which meet the requirements as set forth in The Graduate College Thesis Manual must also be filed with the Thesis Office, University Library. A charge of $50 will be made to cover Library costs, microfilming of the dissertation, and publication of a 500-word abstract in Dissertation Abstracts. The abstract should cover the entire dissertation and should not be considered as excluding publication of a journal article.

Final Examination. A final examination shall be taken on all graduate work, including dissertation. This examination shall be conducted by the student’s committee with such other members of the faculty as may be designated by the dean of the Graduate College. It will be written or oral, or both, as determined by the committee.

Graduation Approval Slip. These slips are prepared by the Office of Student Records about two weeks prior to the end of a quarter. Candidates wishing to secure this form at any earlier date should file a request with the Office of the Graduate Dean at least three days prior to the time the form is needed.
Definition of a Credit

The value of each course is stated in quarter credits. A one-credit course requires one recitation involving two hours of preparation or one three-hour laboratory period or other combination of teacher-student contact and outside preparation involving a total of three clock hours per week for 11 weeks. The abbreviation "Cr. R." in a course description indicates that the course is required but no credit is given.

Course Numbers

The courses in each department are numbered from 1 to 699, according to the following groups:

1-99—Courses not carrying credit toward a bachelor's degree. Primarily for the Technical Institute.
100-299—Courses primarily for freshman and sophomore students.
300-499—Courses primarily for junior and senior students.
500-599—Courses primarily for graduate students, but open to qualified undergraduates.
600-699—Courses for graduate students only.

The value of each course is stated in quarter credits. After the title of each course are two numbers in parentheses. Generally, the first number indicates the number of lecture and recitation hours a week and the second, the number of laboratory hours per week. However, there may be other combinations of teacher-student contact and outside preparation totaling approximately three clock hours per week per credit for a quarter.

At the end of the first line of each course description will be found one or more of the following letters: F. W. S. SS., indicating which of the four quarters—fall, winter, spring, summer session—of the academic year the course is offered. Alt. is the abbreviation for alternate. "Alt. W. Offered 1970" identifies courses to be available during winter quarter of the 1969-70 academic year. The abbreviation Yr. is used to designate a sequence of three courses taught fall, winter, and spring, respectively. If there is sufficient demand, courses may be offered more frequently than announced.

Course Prerequisite

A statement to indicate the background in a subject matter field or the academic maturity suggested so that a student can be ready to undertake the course. Specific courses as prerequisites are usually listed but it is understood the equivalent preparation is satisfactory. It is the instructor's prerogative to waive prerequisites at any time in courses for which he is responsible.

AEROSPACE ENGINEERING

Ernest W. Anderson, Ph.D., Head of Department

Professors: Cheng-Ting Hsu, Ph.D.; James D. Iversen, Ph.D.; Merlin L. Millett, Jr., Ph.D.
Associate Professors: Dale A. Anderson, Ph.D.; Fredrick W. Stuve, M.S.
Instructors: Robert A. Mohling, M.E.; Howard L. Power, M.S.; Richard R. Wear, M.S.

Undergraduate Study

For undergraduate curriculum in aerospace engineering leading to the degree Bachelor of Science, see College of Engineering, Curricula.
The curriculum in aerospace engineering is designed to provide the student with basic training in the principles pertaining to the structure and design, dynamics, propulsion, and testing of flight vehicles which operate in an atmosphere, free space, or hydrospace. To the graduate in aerospace engineering, the field offers a wide variety of opportunities ranging from research and development, design and production to sales and management. These opportunities extend into the fields of space, hydrospace, missiles, and aircraft flight.

A cooperative work-study program in aerospace engineering is available in conjunction with several industries and governmental concerns. The usual four-year curriculum is extended over a five-year span to permit alternate industrial experience periods and academic periods. This arrangement offers valuable practical experience and financial assistance during the college years. See College of Engineering, Cooperative Programs.

Graduate Study

The department offers work for the degrees Master of Engineering and Master of Science with major in aerospace engineering, and minor work to students taking major work in other departments. Work may be taken for the degree Doctor of Philosophy as a divided major with other departments offering work in related fields for this degree. No foreign language is required for the degrees Master of Engineering, Master of Science, and Doctor of Philosophy. However, the completion of a minimum of 9 credits of additional course work not directly related to the major is required for the degree Doctor of Philosophy. These courses are intended for the cultural enrichment of the student and are subject to the approval of the student's committee.

Prerequisite to major graduate work is the completion of a curriculum substantially equivalent to that required of undergraduate students in aerospace engineering at this institution.


COURSES PRIMARILY FOR UNDERGRADUATE STUDENTS

100. TECHNICAL LECTURE.
(1-0) Cr. R; S.
Orientation in the field of aerospace engineering.

240. INTRODUCTION TO AEROSPACE ENGINEERING.
(1-3) Cr. 2. F.
Prerequisite: Math. 111, Phys. 221.
Historical developments in aeronautics and astronautics. How certain aviation problems have been solved using design principles.

244. AERODYNAMICS I.
(3-0) Cr. 3. F.
Prerequisite: Math. 111, Phys. 221.
Introduction to incompressible aerodynamics. The concepts of conservation of mass, momentum, and energy.

245. AERODYNAMICS II.
(3-0) Cr. 3. W.
Prerequisite: 244.
Aircraft and wing nomenclature. Nature and theory of aircraft forces and moments. Introduction to viscous and compressibility effects.

246. PERFORMANCE OF AEROSPACE VEHICLES.
(3-0) Cr. 3. S.
Prerequisite: 245.
Performance of aerospace vehicles.

271, 272. AEROSPACE LABORATORY.
(0-3) Cr. 1 each. W.S.
Prerequisite: 271: Credit or classification in 245; 272: Credit or classification in 246.
Practical application of aerospace principles and concepts through laboratory experiments.

300. INSPECTION TRIP.
Cr. R; S.
Prerequisite: Junior aerospace engineering classification.
Inspection trip to aerospace industrial and government facilities.

309. REACTION PROPULSION I.
(3-0) Cr. 3. S.
Prerequisite: M.E. 321.
One-dimensional gas-dynamics and applications to nozzles, ducts, and diffusers.

320. STRESS ANALYSIS AND MATERIALS.
(3-0) Cr. 3. W.
Prerequisite: E.M. 325, Met. 231.
Properties of materials used in flight vehicles, objectives of design, analysis of elementary structures.

321. STRUCTURAL ANALYSIS.
(3-0) Cr. 3. S.
Prerequisite: 320.
Use of energy methods and matrices in the calculation of deflections of structures of flight vehicles and in the analysis of statically indeterminate structures of flight vehicles. Analysis of webs in shear.

340. INTRODUCTION TO AERODYNAMICS.
(3-0) Cr. 3. W.
Prerequisite: Math. 112.
Introduction to the aerodynamics of powered flight of manned aircraft and missiles. For non-aerospace engineering majors.

343. STABILITY AND CONTROL I.
(3-0) Cr. 3. F.
Prerequisite: 246, Math. 321, E.M. 345.
Static stability and control of flight vehicles. Rigid body equations of motion.
411. REACTION PROPULSION II. 
(3-0) Cr. 3. E.
Prerequisite: 309.
Turbofan, turbojet, turboprop, ramjet, and rocket propulsion system principles.

412. REACTION PROPULSION III. 
(3-0) Cr. 3. S.
Prerequisite: 411.
Combustion in rocket engines, solid rocket fuels, hardware needs for liquid fuel rockets, nuclear and ion propulsion devices.

413. REACTION PROPULSION IV. 
(3-0) Cr. 3. S.
Prerequisite: 413.
Exotic space propulsion systems. Unsteady performance, dynamics, and control of turbo-engines. Blade element theory as applied to propellers and axial flow compressors, turbines and fans.

421. PROBLEMS IN FLIGHT VEHICLE HEATING. 
(3-0) Cr. 3. W.
Prerequisite: 321, M.E. 321.
Sources of flight vehicle heating. Effect of heating on the structural analysis and design.

423. ADVANCED STRUCTURAL ANALYSIS. 
(3-0) Cr. 3. S.
Prerequisite: 321.
Special methods of structural analysis, stability of structures typical of modern aerospace vehicles.

431. FUNDAMENTALS OF FLIGHT CONTROL. 
(3-0) Cr. 3. F.
Prerequisite: 344, E.E. 441, Math. 322.
Fundamental knowledge pertaining to the analysis of automatic control systems for flight vehicles.

432. FLIGHT CONTROL SYSTEMS. 
(3-0) Cr. 3. W.
Prerequisite: 431.
Control, guidance, and navigation systems as related to the performance of aerospace vehicles.

433. FLIGHT SYSTEMS TESTING. 
(0-3) Cr. 3. S.
Prerequisite: 432.
Application of instrumentation to flight systems. Reduction and analysis of experimental data as obtained from aerospace systems. Aircraft, missile, and satellite testing.

441. AERODYNAMIC THEORY I. 
(3-0) Cr. 3. F.
Prerequisite: 343, M.E. 321.
Introduction to classical theory of compressible and incompressible fluids. Shock and expansion waves.

442. AERODYNAMIC THEORY II. 
(3-0) Cr. 3. W.
Prerequisite: 441.
Principles of compressible and incompressible flow. Application to airfoils, wings, and solids of revolution.

443. VISCOUS AERODYNAMIC THEORY. 
(3-0) Cr. 3. S.
Prerequisite: 442.

446. AEROSPACE VEHICLE PERFORMANCE. 
(3-0) Cr. 3 each. 445; W; 446: S.
Prerequisite: 445; 344; 446: 445.
Introduction to the aerodynamics, performance, stability, control, and critical maneuvering characteristics of aerospace vehicles such as V/STOL aircraft, helicopters, hovercraft, and other short-range transportation vehicles.

452, 453. FLIGHT MECHANICS II AND III. 
(3-0) Cr. 3 each. 452; W; 453: S.
Prerequisite: 352.

455, 456. INTRODUCTION TO HYDROSPACE ENGINEERING. 
(3-0) Cr. 3 each. 455; W; 456: S.
Prerequisite: 455: Math. 213; 456: 344; 456.
Introduction to elementary hydrospace vehicle performance, stability and control, and physical oceanography. Application of hydrospace principles to motion of vehicles under, on, or above the surface and instrumentation for hydrospace research.

461. DESIGN AND ANALYSIS I. 
(3-0) Cr. 3. F.
Prerequisite: Senior classification.
Concepts of systems design as related to aerospace problems.

462. DESIGN AND ANALYSIS II. 
(1-6) Cr. 3. W.
Prerequisite: 461.
Application of the principles and methods of analysis and design to the solution of aerospace problems.

463. DESIGN AND ANALYSIS III. 
(1-6) Cr. 3. S.
Prerequisite: 462.
Application of the principles and methods of analysis and design to the solution of aerospace problems.

471, 472, 473. SENIOR PROJECTS. 
(0-3) Cr. 1 each. F.W.S.
Prerequisite: 471; Credit or classification in 411, 431, 441, 472; 471: 473; 472:
Development of aerospace principles and concepts through individual projects.

480. FUNDAMENTALS OF AERORESTICITY. 
(3-0) Cr. 3. S.
Prerequisite: 321, 344, E.M. 444.
Application of vibration theory and matrix analysis to elastic structures; eigen-value solutions of boundary value problems. Introduction to aerelasticity and flutter.

490. SPECIAL PROBLEMS. 
Arr. Cr. 1 to 6.
Prerequisite: 344.
A. Aero and/or Gaseodynamics.
B. Propulsion.
C. Stress Analysis.
D. Flight Mechanics.
E. Flight Systems.
F. Hydrospace.
G. Aerelasticity.
H. Honors.

491, 492, 493. AEROSPACE SEMINAR. 
(1-0) Cr. R; Y.
**COURSES PRIMARILY FOR GRADUATE STUDENTS, major or minor, open to qualified undergraduates**

524. THERMODYNAMICS OF COMPRESSIBLE FLOW II.
(M.E. 524) See Mechanical Engineering.

531. 532. AUTOMATIC CONTROLS FOR FLIGHT VEHICLES.
(3-0) Cr. 3 each. 531: Alt. W; 532: Alt. S, offered 1972.
Prerequisite: 431 or equivalent.

541, 542, 543. ADVANCED AERODYNAMICS.
(M.E. 541, 542, 543) (3-0) Cr. 3 each. Yr.
Prerequisite: 441.
Classical flow theory, compressible fluid theories, shock wave studies, and applications to aerodynamic shapes.

544. ADVANCED AERODYNAMICS.
(3-0) Cr. 3. F.
Prerequisite: 543.
Applications of classical flow theory, compressible fluid theories, and shock wave studies to aerodynamic shapes.

545. FLIGHT PROPULSION SYSTEMS.
(M.E. 545) See Mechanical Engineering.

549. EXPERIMENTAL GAS DYNAMICS AND SHOCK TUBE THEORY.
(M.E. 549) See Mechanical Engineering.

**COURSES FOR GRADUATE STUDENTS, major or minor**

610, 611. AEREOELASTICITY.
(3-0) Cr. 3 each. 610: Alt. W; 611: Alt. S, offered 1972.
Prerequisite: 644, E.M. 444 or equivalent.
Interaction of aerodynamic, elastic, and inertial forces and the influence of this interaction on airplane design. Steady and unsteady aeroelastic problems.

615, 616. OPTIMIZATION IN AEROSPACE ENGINEERING.
Prerequisite: 551, 543.
Applications of calculus of variations, method of gradients, dynamic programming, and other optimization techniques to problems in aerodynamics, flight mechanics, design, etc.

620. SEMINAR.
(1-0) Cr. 1.

623, 624. MAGNETOFLUIDDYNAMICS AND PLASMA DYNAMICS.
Prerequisite: 541, 642, 643, Math. 322.

628. RADIATION GAS DYNAMICS.
Prerequisite: 623.
Macroscopic treatment of the radiative energy transfer in gases. Conservation equations for radiation gas dynamics. Applications to one dimensional flow, normal shock waves and plane acoustic waves.

641, 642. HYPersonic FLOW THEORY.
Prerequisite: 543 or equivalent.

643. HYPERSONIC VIScOUS FLOWS.
(3-0) Cr. 3. Alt. S, offered 1972.
Prerequisite: 642.
Hypersonic boundary layer and viscous flow studies. Applications to slender and blunt bodies.

644. APPLIED WING THEORY.
(3-0) Cr. 3. Alt. F, offered 1971.
Prerequisite: 541, 544.
Methods of estimating the aerodynamic characteristics of swept and unswept, steady and oscillating wings in subsonic and supersonic flight.

647. 648, 649. THE DYNAMICS OF REAL GASES.
(3-0) Cr. 3 each. Alt. Yr, offered 1971.
Prerequisite: 543, Math. 322.
Application of real gas theory to flow behind a strong shock and in a rocket expansion nozzle. Involves harmonic and subharmonic oscillator theory, collisional transition probabilities, vibrational and chemical relaxation, together with their coupling effects at high temperatures.

650. FLUID MECHANICS SEMINAR.
(E.M. 650, M.E. 650) (1-0 to 3-0) Cr. 1 to 3 each time taken. F.
Prerequisite: Permission of instructor.
Special topics of current research interest to students and staff of departments concerned.

651, 652. MECHANICS OF SPACE VEHICLE TRANSFERS.
Prerequisite: 551.
Vehicle transfer from one orbit to another orbit. Intercept and rendezvous techniques using rocket and/or aerodynamic forces. Lunar and interplanetary space vehicle trajectories. Low-thrust space trajectories. Maneuvering of entry vehicles using rocket and/or aerodynamic forces.

690. SPECIAL TOPICS FOR ADVANCED GRADUATE STUDENTS.
Cr. 1 to 5.
A. Aero and/or Gasdynamics.
B. Propulsion.
C. Stress Analysis.
D. Flight Mechanics.
E. Flight Systems.
F. Magnetofluidodynamics.
G. Hydrospace.
H. Viscous Aerodynamics.

699. RESEARCH.

AGRICULTURAL BUSINESS

For courses in agricultural business, see Economics, Courses and Programs.

AGRICULTURAL EDUCATION

Harold R. Crawford, Ph.D., Chairman of Department

Professors: Clarence Bundy, M.S.; Glenn E. Holmes, M.S.; Roger L. Lawrence, Ph.D.; John McClelland, Ph.D.; Vilas J. Morford, M.S.

Associate Professor: Thomas A. Hoerner, Ph.D.

Assistant Professors: Alan A. Kahler, Ph.D.; Windol L. Wyatt, M.S.

Instructor: Joseph F. Bendixen, Ph.D.

Undergraduate Study

For undergraduate curriculum in agricultural education leading to the degree Bachelor of Science, see College of Agriculture, Curricula.

The curriculum in agricultural education prepares persons for careers as vocational agriculture instructors, agricultural extension workers, or as educational personnel in related agricultural businesses and industries.

Graduate Study

The department offers work for the degrees Master of Science, Master of Education, and Doctor of Philosophy with a major in agricultural education and minor work to students taking major work in other departments.

Prerequisite to major graduate work in agricultural education is preparation substantially equivalent to the completion of the undergraduate curriculum in agricultural education offered at Iowa State University and adequate proof that the student ranks above average in scholastic ability and promise of vocational competency.

There is no foreign language requirement for the degrees Master of Science or Master of Education. A satisfactory reading knowledge of two languages—French, German, Russian, or Spanish—is required of doctoral candidates. At the discretion of the student's graduate program committee, the foreign language requirement may be met by: (1) demonstrating a satisfactory reading knowledge of two foreign languages; (2) demonstrating a significantly higher degree or competence in one foreign language; (3) substituting two years of undergraduate study with a B average for one language; (4) substituting 9 credits of graduate work, in addition to the minimum Ph.D. requirements, in approved areas for one language or 18
COURSES PRIMARILY FOR UNDERGRADUATE STUDENTS

110. ORIENTATION IN AGRICULTURAL EDUCATION.
(1-0) Cr. R: F.W.

211A, 211B. OBSERVATION AND SURVEY OF PROGRAM OF EDUCATION IN AGRICULTURE.
(3-0) Cr. 1 each: A: F.S; B: F.S.
211A. Agricultural Education. Visitation of high school departments of agriculture. Survey of day school, young and adult farmer programs. Field trips. 211B. Extension Education. Visitation of central staff departments, county programs, and special day activity observation and discussion of extension education programs in agriculture and home economics. Field trips.

321. PLANNING THE PROGRAM IN VOCATIONAL AGRICULTURE.
(2-3) Cr. 3. F.W.S.
Prerequisite: Educ 305.
Organization and analysis of the program of vocational agriculture. Course organization, library, departmental program of work, summer programs, advisory councils, and Future Farmers of America activities. Departments are visited to observe programs and results.

412. METHODS OF TEACHING VOCATIONAL AGRICULTURE IN HIGH SCHOOL.
(3-1) Cr. 3. F.W.S.
Prerequisite: 321.
Decision-making approach, selection of method, lesson planning, class management, farming, and occupational experience programs. Departments are visited to observe programs and results.

414. YOUNG FARMER AND ADULT EDUCATION IN AGRICULTURE.
(3-1) Cr. 3. F.W.S.
Prerequisite: 321.
Methods of organizing and teaching classes in vocational agriculture and technical school programs for persons employed in farming and off-farm agriculture. Departments are visited to determine best practices.

417. OBSERVATION AND SUPERVISED TEACHING IN AGRICULTURE.
Cr. 3 to 12. F.W.S.
Prerequisite: 412, 414.
Three to nine weeks of full-time observation and supervised teaching in public schools. To be scheduled with "as arranged" courses and special sections.

490. SPECIAL PROBLEMS IN AGRICULTURAL EDUCATION.
Cr. 1 to 6.
Prerequisite: Junior classification, quality-point average of 2.5 or more for preceding two quarters.

COURSES PRIMARILY FOR GRADUATE STUDENTS, major or minor, open to qualified undergraduates

511. INSTRUCTIONAL AND ORGANIZATIONAL PROBLEMS OF BEGINNING TEACHERS OF VOCATIONAL AGRICULTURE.
(3-0) Cr. 3. Off-campus only. F.W.
Prerequisite: Fifteen credits in education.
Problems in instructional planning and methodology and in organizing the presecondary, secondary, postsecondary, FFA, and agricultural experience programs.

520. INSTRUCTIONAL TECHNIQUES AND MATERIALS IN AGRICULTURAL EDUCATION.
(3-0) Cr. 3. W. Off-campus. S.
Prerequisite: Fifteen credits in education.
Innovations and advanced principles in teaching methods and instructional plans and materials. Teaching decision making, programmed learning, demonstrations, field trips, team teaching, reference material selection, development and evaluation of instruction.

521. PROGRAMS FOR LEADERSHIP DEVELOPMENT IN AGRICULTURAL EDUCATION.
(3-0) Cr. 3. Alt. F, offered 1971.
Prerequisite: Fifteen credits in education.
Identification of leadership needs of participants in agricultural education programs. Principles of leadership development. Organization, implementation, and evaluation of individual and group leadership programs at presecondary, secondary, and postsecondary levels.

538. POST HIGH SCHOOL EDUCATION IN AGRICULTURE.
(3-0) Cr. 3. Off-campus only. S.
Prerequisite: Fifteen credits in education.
Problems and needs of young and adult farmers and workers in off-farm agriculture, survey techniques, use of advisory councils, administrative relationship problems, program planning and evaluation. Departments are visited to observe programs and results.

539. OCCUPATIONAL EXPERIENCE PROGRAMS IN VOCATIONAL AGRICULTURE.
(3-0) Cr. 3. Alt. S, offered 1972.
Prerequisite: Fifteen credits in education.
Purposes of farm and off-farm occupational experience programs. Analysis of farm and off-farm employment-experience opportunities.

540. EDUCATIONAL IMPLICATIONS OF MANPOWER NEEDS IN AGRICULTURE.
(3-0) Cr. 3. Alt. F, offered 1972.
Prerequisite: Fifteen credits in education.
Analysis of manpower needs of farm and off-farm agriculture in individual communities, state, and nation. Methods in analyzing situations and in planning individual programs.

590. SPECIAL TOPICS IN AGRICULTURAL EDUCATION.
Cr. 1 to 5.
Prerequisite: Fifteen credits in education.
593. WORKSHOP IN AGRICULTURAL EDUCATION.
Cr. 1 to 5. F.W.S.S.
Prerequisite: Fifteen credits in education.

A. High school vocational agriculture teachers.
B. Beginning vocational agriculture teachers.
C. Post-secondary agricultural teachers.
D. Cooperating teachers.

COURSES FOR GRADUATE STUDENTS, major or minor

604. EVALUATION AND PROGRAM PLANNING IN AGRICULTURAL EDUCATION.
(3-0) Cr. 3. SSF. Alt. S. offered 1973.
Prerequisite: Fifteen credits in education.
Criteria and procedures for evaluation of programs in agricultural education. Adoption and implementation of evaluation results in program organization, administration, and content.

615. SEMINAR IN AGRICULTURAL EDUCATION.
(1-0 to 3-0) Cr. 1 to 3. F.W.S.S.

630. PHILOSOPHY AND POLICY MAKING IN AGRICULTURAL EDUCATION.
(3-0) Cr. 3. Alt. W, offered 1973.
Prerequisite: Fifteen credits in education.
Basic philosophic premises in development of agricultural education programs at federal, state, and local levels. Impact of legislation on state and local policy making. Role of state and local advisory groups in policy making.

699. RESEARCH.

AGRICULTURAL ENGINEERING

Clarence W. Bockhop, Ph.D., Head of Department


Assistant Professors: Willard R. Anderson, M.S.; Harvey J. Hirning, Ph.D.; Stewart W. Melvin, Ph.D.

Instructors: George E. Ayres, M.S.; Carl J. Bern, M.S.; H. Edward Breece, M.S.; Herbert E. Hansen, B.S.; Clark W. Hanson, B.S.; Hilbert J. Hoof, M.A.; James I. Warner, B.S.

Undergraduate Study

For the undergraduate curriculum in agricultural engineering leading to the degree Bachelor of Science, see College of Engineering, Curricula.

The curriculum in agricultural engineering provides training in the major fields of engineering applications to the industry of agriculture. Graduates from the curriculum find employment in agricultural production enterprises, in industries which supply goods and services to agriculture, and in the state and federal agencies responsible for agricultural engineering research, application, and education.

Employment for agricultural engineers is available in many agricultural industries. Professional services performed in the farm-equipment industry include engineering design, development, manufacturing, product education, and sales. Services are rendered to industries supplying farm building materials and equipment, and in the design, construction, merchandising, and contracting of farm buildings. Students may also prepare for employment in design, development, construction, sales, and service in the areas of soil erosion control, drainage, and irrigation; rural electrification; crop processing and storage; and materials handling in agriculture.

The department has cooperative programs established for interested and qualified students. The four-year curriculum is extended over a five-year period and interspersed with work periods at cooperating organizations. This plan offers valuable practical experience and financial assistance during the years in college.

The department offers a number of courses for students from the College of Agriculture.
These include courses in agricultural mechanics, soil and water management, power and machinery, electric power, structures and environment, and crop storage and conditioning.

Graduate Study

The department offers work for the degrees Master of Science, Master of Engineering, and Doctor of Philosophy with major in agricultural engineering. Within the major the student may specialize in soil and water resources, field power and machines, materials handling, crop conditioning and processing, agricultural structures and environment, and animal waste management.

Prerequisite to major graduate work is the completion of an undergraduate curriculum substantially equivalent to that required of agricultural engineering undergraduate students at this institution.

Minor work in agricultural engineering is offered for students in other departments, and minor work in agricultural mechanics is offered for students in agriculture.

A foreign language is not required for the degree of Master of Science or Master of Engineering. The language requirement for the degree Doctor of Philosophy may be satisfied by one of three ways: (1) Demonstrate a satisfactory reading knowledge of two foreign languages approved by the department. (2) Demonstrate a significantly higher degree of communication competence for one foreign language. (3) Demonstrate a satisfactory reading knowledge of one foreign language and scholarly achievement in a minimum of 9 credits of course work in the social sciences and humanities.


COURSES PRIMARILY FOR UNDERGRADUATE STUDENTS

*100. TECHNICAL LECTURE. (1-0) Cr. R; S. The field of agricultural engineering, its relation to the agricultural industry and to the engineering profession.

134. FARM MACHINERY MANAGEMENT.1 (1-2) Cr. 2. W. For students in Winter Quarter Farm Operation Program only. Calibration, selection, management, and cost of using farm machinery.

136. POWER SOURCES FOR AGRICULTURE. (2-3) Cr. 3. S. For students in two-year programs in Agriculture only. Production uses of gasoline engines in agricultural enterprises. Principles and operation of the internal combustion engine. Horsepower conversion, cost of operation, and efficiency as related to agricultural equipment.

154. AGRICULTURAL MAINTENANCE WELDING.2 (2-4) 5 weeks. Cr. 2. W. For students in Winter Quarter Farm Operation Program only. Selection of welding machines and materials and their application in agriculture.

164. ELECTRICAL EQUIPMENT FOR FARMS. (0-4) Cr. 2. W. For students in Winter Quarter Farm Operation Program only. Selection, application, and maintenance of electrical equipment used in the electrification and mechanization of farmsteads.

219. ENGINEERING PROBLEMS IN LIVESTOCK MANAGEMENT. (3-0) Cr. 3. W.

1A student cannot count credit for both 134 and 334 toward a degree.

2A student cannot count credit for both 154 and 254 toward a degree.

For Winter Quarter Farm Operation Program only. Space and equipment needs and arrangements for livestock production. Environmental influence on animal performances and behavior. Materials handling problems.

*230. AGRICULTURAL ENGINEERING CONCEPTS I. (3-3) Cr. 4. F. Prerequisite: Credit or classification in Math. 111 and Phys. 221. Introduction to concepts of energy and mass flow. Analysis of the atmospheric environments. Aspects of agricultural hydrology.

*231. AGRICULTURAL ENGINEERING CONCEPTS II. (3-3) Cr. 4. W. Prerequisite: 230, credit or classification in Phys. 222. Basic concepts in crop storage and livestock production. Engineering analysis of the physical and thermal environment for animal and stored crops. Introduction to environmental control for animal and crop systems.

*232. AGRICULTURAL ENGINEERING CONCEPTS III. (3-3) Cr. 4. S. Prerequisite: 230, credit or classification in Agron. 154A and Bot. 410. Considerations in soil and water utilization. Analysis of the elements of plant environment. Concepts involved with crop production, including tillage, seeding, cultivation, and harvesting.

254. METAL CONSTRUCTION AND MAINTENANCE.2 (2-4) Cr. 3. F.W.S.S. Selection and application of ferrous and nonferrous metals. Welding, cold-working, and hot-working metal in agricultural construction and maintenance.
255. AGRICULTURAL CONSTRUCTION MATERIALS AND PROCEDURES.
(2-4) Cr. 3. F.W.S.SS.
Selection of building materials and their application to agricultural construction.

259. MATERIALS AND PROCESSES.
(0-6) Cr. 3. F.
Prerequisite: Chem. 142.
Properties and behavior of metallic and nonmetallic materials. Welding, metallurgy, and heat treatment of ferrous and nonferrous metals and alloys.

301. 302. 303. SEMINAR.
(1-0) Cr. R; Yr.
Preparation, presentation, and discussion of papers on agricultural engineering subjects.

306. SOIL AND WATER MANAGEMENT.
(2-3) Cr. 3. F.S.SSI.
Engineering aspects of soil and water conservation for students in agriculture. Use of the level. Land description. Design, location, and construction of erosion control and drainage facilities. Field trips to problem areas.

334. FARM MACHINERY AND POWER MANAGEMENT.
(3-3) Cr. 4. F.W.S.
Mechanics and materials of farm machinery construction. Adjustment, selection, capacity, and cost of use of farm machinery. Transmission, measurement, and cost of use of farm power.

344. SMALL POWER EQUIPMENT.
(2-3) Cr. 3. F.S.
Prerequisite: Junior classification.
Operation, adjustment, and maintenance of small internal combustion engines and associated equipment.

345. TRACTOR POWER.
(2-3) Cr. 3. W.
Prerequisite: 334.
Construction, operation, adjustment, capacity, and care of tractors and internal combustion engines.

346. AGRICULTURAL TRACTOR POWER.
(3-3) Cr. 4. S.SSI.
Prerequisite: M.E. 321.
Kinematics and dynamics of tractor power application; draw bar, power take-off, and traction mechanisms. Thermodynamic principles and construction of the internal combustion engine, fuels and carburetion, ignition. Rating and testing of tractors.

354. ADVANCED METAL CONSTRUCTION AND MAINTENANCE.
(2-4) Cr. 3. F.W.S.SSI.
Prerequisite: 254.
Advanced techniques in metal construction and repair of agricultural equipment including oxyacetylene and arc welding.

359. MACHINE CONSTRUCTION.
(2-4) Cr. 3. F.W.S.SSI.
Oxyacetylene and electric welding. Chemical and metallurgical principles. Selection of equipment and materials.

364. FARM ELECTRICITY.
(2-3) Cr. 3. F.W.S.SSI.
Use of electricity in productive farm enterprises and in the improvement of farm living. Electrical safety and protection. Motors, controls, and wiring for work simplification.

366. CROP CONDITIONING AND HANDLING SYSTEMS.
(2-3) Cr. 3. F.
Prerequisite: Junior classification.
Principles, methods, and management practices in drying agricultural crops with emphasis on corn. Principles and selection of materials-handling systems, including augers, bucket elevators, and belt conveyors.

371. WATER USE IN OUTDOOR RECREATION.
(3-0) Cr. 3. W.
Prerequisite: Junior classification.
Recognition and definition of problem areas in outdoor recreation. Water sources, quantity and quantity considerations, wastes disposal, irrigation and drainage, mapping.

377. AGRICULTURAL STRUCTURES AND ENVIRONMENT.
(3-3) Cr. 4. W.
Prerequisite: 231. E.M. 324, classification in M.E. 321.

401. 402. 403. SEMINAR.
(1-0) Cr. R; Yr.
Preparation, presentation, and discussion of papers on agricultural engineering subjects.

411. AGRICULTURAL MACHINERY MAINTENANCE AND ADJUSTMENT.
Prerequisite: Permission of Instructor.
Operating principles, adjustment, and maintenance of tillage, planting, fertilizing, spraying, and harvesting equipment.

412. ELECTRICITY IN FARMSTEAD MECHANIZATION.
Prerequisite: Permission of Instructor.
Planning the farmstead electrical systems for economy, work simplification, and safety. Characteristics and application of motors and controls to livestock and poultry production. Development of demonstrations and instructional materials for the teaching of mechanization of the farmstead.

415. TEACHING AGRICULTURAL MECHANICS I.
(2-2) Cr. 3. F.W.
Prerequisite: 254, 255.
Objectives and methods; equipment and management of the shop; organization of shop program. Students will plan and present demonstrations of methods of teaching mechanical skills.

417. TEACHING AGRICULTURAL MECHANICS II.
(3-0) Cr. 3. S. Off-campus.
Prerequisite: 415.
Organization of instructional units; selection of tools, equipment, supplies, and reference materials; development and organization of facilities for instruction in high school and vocational-technical programs.

418. DEVELOPMENTS IN AGRICULTURAL MECHANICS.
(1-2 or 2-4) Cr. 1 or 2. F.W.SS. Off-campus.
Five weeks.
Selection, principles of operation, application and maintenance of equipment and materials used in mechanized agriculture and development of instructional units for vocational-technical programs.
A. Small Gasoline Engines.
B. Electric Motors.
C. Controls for Automation in Agriculture.
D. Electricity in Agriculture.
E. Materials for Agricultural Structures.
F. Tractor Engines.
G. Hydraulics in Agriculture.
H. Metal Construction.
I. Agricultural Machinery.
419. ENVIRONMENTAL SYSTEMS FOR ANIMAL PRODUCTION.
(3-0) Cr. 3. F.S.SSI.
Prerequisite: Junior classification.

*424. HYDRAULIC DESIGN OF SOIL AND WATER CONTROL FACILITIES.
(3-3) Cr. 4. W.
Prerequisite: E.M. 378.
Application of open-channel flow principles to the design of irrigation, drainage, and erosion control facilities. Hydraulics of conduits, and stilling basins. Hydraulics of pumps. Spatially steady flows. Flow through porous media.

*425. IRRIGATION AND DRAINAGE ENGINEERING.
(2-3) Cr. 3. S.
Prerequisite: 232, 424.

*435. AGRICULTURAL MACHINERY DESIGN I.
(0-3) Cr. 1. F.
Prerequisite: Credit or classification in M.E. 420.
Creative approach to identification and analysis of agricultural machinery needs, critical evaluation of proposed solutions.

*436. AGRICULTURAL MACHINERY DESIGN II.
(2-6) Cr. 4. W.
Prerequisite: 232, 435, credit or classification in M.E. 421.
Design, development, and testing of farm machinery to meet the functional requirements of machines for tillage, seeding, cultivation and weed control, harvesting, crop processing, and farm power units.

*437. POWER AND CONTROL HYDRAULICS.
(2-2) Cr. 3. S.
Prerequisite: E.M. 378.
Significance of hydraulic fluid properties. Performance parameters for fixed and variable displacement pumps and motors. Analysis of pressure, flow, and directional control valves. Analysis and design of hydraulic systems for power and control functions.

*461. ELECTRICAL ENERGY APPLICATIONS IN AGRICULTURE.
(2-6) Cr. 4. F.
Prerequisite: Credit or classification in E.E. 445.
Characteristics of motors and controls and applications to agricultural machines. Instrumentation and techniques applied to agricultural production.

*464. CROP CONDITIONING AND STORAGE.
(2-3) Cr. 3. W.
Prerequisite: Math. 321, M.E. 321.

*485. PROPERTIES AND PROCESSING OF AGRICULTURAL MATERIALS.
(2-3) Cr. 3. S.
Prerequisite: 231.
Theory and practice involved in the handling of agricultural products. Rheological, thermal, and mechanical properties of products. Component and system design.

*471. PRINCIPLES OF LIVESTOCK WASTE MANAGEMENT.
(3-3) Cr. 4. S.
Prerequisite: Chem. 321.
Principles of chemistry, bacteriology, and engineering applied to the collection, treatment, and disposal of animal wastes.

*477. ADVANCED AGRICULTURAL STRUCTURES AND ENVIRONMENT.
(2-4) Cr. 4. W.
Prerequisite: 377, M.E. 426, C.E. 434.
Analysis and design of light framed structures and environmental control systems for animal production, plant production, crop storage and processing of agricultural products.

*490. SPECIAL PROBLEMS.
Cr. 1 to 5.
H. Honors.
P. Power and Machinery.
Q. Structures and Environment.
R. Electric Power and Processing.
S. Soil and Water.
T. Construction and Maintenance.

*Courses primarily for undergraduate engineering students.

COURSES PRIMARILY FOR GRADUATE STUDENTS, major or minor, open to qualified undergraduates

524. EROSION AND SEDIMENT TRANSPORT.
(3-0) Cr. 3. Alt. F, offered 1971.
Prerequisite: Math. 213 and one of the following: 424, C.E. 571, Geol. 431, Agron. 577.

528. FREQUENCY DISTRIBUTIONS IN HYDROLOGIC DATA ANALYSIS.
(3-0) Cr. 3. Alt. W, offered 1972.
Prerequisite: Stat. 401 or 447.
Theory and use of log normal, Weibull, and extreme value distributions. Application of computer programs to fit selected hydrologic data.

531. DESIGN CRITERIA FOR AGRICULTURAL STRUCTURES.
(3-0) Cr. 3. F.
Prerequisite: 377.
Development of physical and environmental design criteria essential to buildings and related equipment used in the production of livestock and storage of crops. Research needs and techniques.

532. ADVANCED SOIL AND WATER CONTROL ENGINEERING.
(3-0) Cr. 3. W.
Prerequisite: 424.
Land and water resource development for agriculture. Relationship of the engineer to resource development. Research and development in soil and water conservation engineering.

533. AGRICULTURAL POWER AND MACHINERY.
(3-0) Cr. 3. S.
Prerequisite: 346.
Critical analysis of power and equipment for agricultural production with emphasis on func-
54. ADVANCED FARM ELECTRIFICATION.
(3-0) Cr. 3. S.
Prerequisite: 461.
Critical analysis of electric power, heat, light, and controls in agricultural production with emphasis on functional design requirements; instrumentation methods and results.

COURSES FOR GRADUATE STUDENTS,
major or minor

637. SOIL DYNAMICS.
Prerequisite: E.M. 324, 345; Agron. 577 or C.E. 360.

638. HARVESTING MACHINES.
Prerequisite: 436, 533.
Principles of cutting, gathering, threshing and separating of grains. Effects of maturity, crop condition, and environment on grain damage and harvesting efficiency. Analysis of harvesting devices.

661, 662, 663. SEMINAR.
(1-0) Cr. 1 each. Yr.
Discussion of research problems, methods, procedures, and reports.

671. ADVANCED TOPICS IN WATER RESOURCES ENGINEERING.
(C.E. 671) See Civil Engineering.

699. RESEARCH.
N. Crop Conditioning and Storage.
P. Power and Machinery.
Q. Structures and Environment.
R. Electric Power and Processing.
S. Soil and Water.

AGRICULTURE

Floyd Andre, Ph.D., Dean of Agriculture
Louis M. Thompson, Ph.D., Associate Dean

Professor: James J. Wallace, B.S.
Assistant Professor: Jack M. Alexander, M.S.


Courses listed below are offered for undergraduate students in all curricula of the College of Agriculture. See also individual curricula in the section College of Agriculture.

104. PRACTICAL WORK.
A minimum of six months' practical work in the student's field of study is required for graduation. This requirement should be met before the beginning of the junior year.

110. FARM OPERATION ORIENTATION.
(1-0) Cr. R; F.W.

290. SPECIAL PROBLEMS.
Cr. 1 to 3.
Prerequisite: Sophomore classification.
Independent study for two-year farm operation students in a specific area for which no course is available and in an area not assigned to an existing department. Approved by the professor in charge of the farm operation curriculum.

450. FARM OPERATION.
(3-4) Cr. 4. F.W. 8.S.
Prerequisite: Econ. 330, junior classification in College of Agriculture.

Participation in the management and operation of an Iowa farm. The class is responsible for the plans, records, and decisions of buying and selling of livestock, crops, and equipment. Trips to farms and markets.

490. SPECIAL PROBLEMS.
Cr. 1 to 3.
Prerequisite: Junior classification in the College of Agriculture.
Independent study of a specific area for which no course is available and in an area not assigned to an existing department. The proposal by the student is subject to the approval of the associate dean or the head of the farm operation curriculum.

499. SENIOR SEMINAR.
Cr. 1. S. Satisfactory-Fail.
Current topics of importance in agriculture. Lectures by College of Agriculture staff and visitors.
AGRONOMY

John T. Peake, Jr., Ph.D., Head of Department


Instructors: Richard E. Carlson, M.S.; George L. Palmer, M.S.; Charles L. Prior, M.S.

Undergraduate Study

For undergraduate curriculum in agronomy, see College of Agriculture, Curricula.

Students electing agronomy as a major will prepare themselves for positions in agricultural industries, businesses, and government. Graduates accept positions in the seed, fertilizer, and chemical industries as agronomists, production managers, and sales and promotion personnel. State and federal agencies employ agronomists as extension specialists, county extension directors, soil scientists, soil conservationists, and food and drug inspectors. Land appraisal, farm management, turfgrass management, and farming are additional areas of work open to agronomists. Students who are reasonably certain of going on to graduate school should elect a soil science, crop science, or climatology minor.

Graduate Study

The department offers work for the degrees Master of Science and Doctor of Philosophy with major in crop production and physiology, plant breeding, soil physics, soil chemistry, soil fertility, soil microbiology and biochemistry, soil morphology and genesis, soil management and agricultural climatology. Minor work is provided for students taking major work in other departments. A nonthesis option is available for the master's degree.

Prerequisite to major graduate work in crop science and soil science is completion of an undergraduate curriculum substantially equivalent to that recommended for pregraduate training in the agronomy curriculum at this institution. The foreign-language requirement, if any, for the M.S. and Ph.D. degrees is established on an individual basis by the program-of-study committee appointed to guide the work of the student.


COURSES PRIMARILY FOR UNDERGRADUATE STUDENTS

110. ORIENTATION IN AGRONOMY.
   (1-0) Cr.  R; F.
   Opportunities, challenges, and scope of agronomy. Assistance in career planning.

114. PRINCIPLES OF CROP PRODUCTION.
   A: (2-3 to 6) Cr. 4. F.W.S.
B: (3-0) Cr. 3. For students in winter quarter farm operation program only.
Introduction to physical, chemical, and biological properties of soils, their formation, classification, and distribution. Rural and urban use.

206. INTRODUCTION TO METEOROLOGY.
(Meteor. 206) (3-0) Cr. 3. F.W.S.
Introduction to basic meteorological processes. The general circulation, solar and terrestrial radiation, fronts, cyclones and anticyclones, weather maps, and forecasting.

212. GRAIN AND FORAGE CROPS.
(3-2) Cr. 4. F.W.S.
Prerequisite: 114.
Crop plant characteristics, adaptation, and quality with major emphasis on the production and management of corn, soybeans, small grains, and forage crops common to Midwest agriculture.

244. SOIL FERTILITY AND CROP MANAGEMENT.
Cr. 3. S.
Prerequisite: 114A, 154A. Open only to two-year Farm Operation students.
Integrating soil fertility and crop management principles and practices into profitable land-use programs. Characteristics and use of fertilizers and agricultural chemicals in crop production.

310. AGRONOMY SEMINAR.
(1-0) Cr. 1. F.S.
Prerequisite: 206, 315, 354, Stat. 101. Interpretation and presentation of research data relating to soil-plant and soil-plant-climate relationships.

314. TURFGRASS MANAGEMENT.
(Hort. 314) See Horticulture.

315. CROP GROWTH AND CULTURE.
(4-0) Cr. 4. F.W.S.Al. SSI, offered 1972.
Prerequisite: 114, Biol. 101, Chem. 231 recommended.
Physiological aspects of crop growth; application to cultural practices.

338. SEED TECHNOLOGY.
(Bot. 338) See Botany.

344. SOIL FERTILITY.
(3-3) Cr. 4. F.W.S.SSI.
Prerequisite: 154, 12 credits of chemistry. Frederic S. Strizel.

357. FOREST SOILS.
(Forest 357) (4-3) Cr. 5. W.
Prerequisite: Chem. 231.
Formation, classification, and occurrence of soils. Physical, chemical, and biological soil factors affecting forest growth.

364. SOIL RESOURCE CONSERVATION.
(2-3) Cr. 3. F.S.
Prerequisite: 154 or 357.

400. AGRICULTURAL TRAVEL COURSE.
Cr. 4. SSI.
Prerequisite: Junior or senior classification, permission of instructor.
B: European Tour, offered 1972.
Students taking this course will also be required to register for An. S. 400 for 4 credits. Tour and study of production methods in major crop and livestock regions of the United States and other countries. Influence of climate, soil, topography, markets, and other factors on livestock and crop production.

406. CLIMATES OF THE CONTINENTS.
(Meteor. 406) (3-0) Cr. 3. W.
Prerequisite: Senior classification.
World climatology and factors controlling it. Climatic analogues as a means of comparing climates. The climates of different continents.

409. CROP PROTECTION.
(3-4) Cr. 3. W.
Prerequisite: Junior classification and 5 credits in biology.
Practices related to the biological, chemical, and cultural control of weeds, insects, and plant diseases, with particular emphasis on the use and principles underlying the herbicide and pesticide technologies.

411. CROP SCIENCE SEMINAR.
(1-0) Cr. 1. W.S.
Prerequisite: Senior classification.
Interpretation and presentation of research data relating to crop science.

413. TURFGRASS SCIENCE.
(Hort. 413) See Horticulture.

415. WORLD CROPS: ADAPTATION AND DISTRIBUTION.
(3-0) Cr. 3. F. Alt. SSI, offered 1973.
Prerequisite: 114, Biol. 101.
Origin and adaptation of crop plants. Influence of environmental factors on distribution and production of cereal, oil, fiber, sugar, and other crops.

417. PRINCIPLES OF CROP PRODUCTION AND MANAGEMENT.
(3-0) Cr. 3. A: Alt. SSI, offered 1972, Three weeks. B: S, offered on request.
Prerequisite: Graduate classification. For those students not majoring in agronomy. Application of principles of crop science and current research information in the solution of crop production problems.

424. PRINCIPLES OF PLANT BREEDING I.
(3-0) Cr. 3. F.S.
Prerequisite: 415 or 315; Gen. 301.
Basic principles used in improvement of field crops. Pure line, mass selection, and multi-line concepts; hybridization, pedigree and bulk systems, backcrossing, inbreeding, and other breeding procedures in relation to self- and cross-fertilizing species.

434. FORAGE AND PASTURE: RESOURCE AND DEVELOPMENT.
(3-0) Cr. 3. F.
Prerequisite: Agron. 212 or 315; An.S. 114. Wedin.
Forage and pasture management in Iowa, U.S., and world. Soil-plant-animal relationships. Role of ruminants as forage converters in temperate and tropical regions. Economic considerations.

438. SEED BIOLOGY.
(Bot. 438) See Botany.

444. SOIL AND CROP MANAGEMENT.
A: Soil Management (2-0) Cr. 2. F.W.S.SSI.
Prerequisite: 354. Strizel.
B: Crop Management (2-0) Cr. 2.
(4-0) Cr. 4. F.W.S.SSI.
Prerequisite: 212 or 315. Woolley.
Integrating the principles of agronomic science with soil and crop management systems and practices. Basic plant-soil-climate relationships are used in solving field problems with emphasis on achieving optimum land use and efficient crop production. While the courses can be taken as single, independent units, it is recommended that they be taken jointly.
451. **SOIL SCIENCE SEMINAR.**  
(1-0) Cr. 1. F.W.  
Prerequisite: Senior classification.  
Interpretation and presentation of research data relating to soil science.

452. **SOIL FERTILITY AND FERTILIZERS.**  
(3-0) Cr. 3. S. Off-campus.  
Prerequisite: 354 and graduate classification.  
Stritzel.  
For graduate students not majoring in agronomy.  
Effects of soil and applied nutrients on plant-soil-climate relationships. Management considerations relative to fertilizer sources, time, and methods of application for major crops.

453. **FERTILIZERS.**  
(3-0) Cr. 3. F.W.  
Prerequisite: 354, Stritzel.  
Types, properties, and production of fertilizers; choice and use of fertilizer in relation to soil properties, environmental conditions, crop requirements, and economic factors.

457. **SOIL CHEMISTRY AND PHYSICS.**  
(3-8 or 3-0) Cr. 3 or 4. W.  
Prerequisite: 354.  
Chemical, physical, and mineralogical properties of soils. Influence of particle size on soil properties. A study of the colloidal system and the movement of materials in soils.

473. **SOIL GENESIS AND SURVEY.**  
(2-5) Cr. 5. F.S.  
Prerequisite: 154 or 357.  
Development, characteristics, and identification of soils; study of soil profiles and surfaces; remote sensing; theory and practice of soil mapping; interpretation and utilization of soil survey information; two 2-day field trips.

483. **WORLD SOIL RESOURCES.**  
Prerequisite: Chem. 141 or 147; junior or senior classification.  
Properties of soils; world soil geography; present and potential productivity of soils in various continents, and factors influencing their utilization.

485. **AGRO-MICROBIOLOGY.**  
(Bact. 485) (3-3 or 5) Cr. 4 or 5. F.S.  
Prerequisite: 154, Bact. 300. Frederick.  
Role of microorganisms in soil-plant environment. Carbon, nitrogen, and mineral transformations. Ecological relationships. Applications to fertility, inoculation, pesticides, pollution control, and feed storage.

490. **SPECIAL PROBLEMS.**  
Cr. arr.  
Open to qualified students, after consultation with professor in special area of interest. Selected studies in crops, soils, or climatology according to needs and interests of student. For foreign students, an analysis of soil, climatic, and crop-production resources of the student's home country is suggested. H. Honors Program.

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**COURSES PRIMARILY FOR GRADUATE STUDENTS, major or minor, open to qualified undergraduates**

500. **ORIENTATION SEMINAR.**  
(1-0) Cr. 1. F.  
Prerequisite: Graduate classification in agronomy, and from foreign country. Pesek and staff.  
An introduction to Iowa and U.S. agriculture for international scholars. Field trips when possible. Departmental role in the functioning of research, teaching, and extension, including the charge given the land-grant university.

505. **MICROCLIMATOLOGY.**  
(Meteor. 505) (3-0) Cr. 3. S.  
Prerequisite: 206, or graduate classification. Shaw.  
The heat exchange near the ground. Relation of topography and plant cover to the microclimate. Modification of microclimate by agricultural operations.

506. **METHODS IN CLIMATOLOGY.**  
(Meteor. 506) (3-0) Cr. 3. Alt. S, offered 1972.  
Prerequisite: 505, Stat. 448. Shaw.  
Physical and statistical processes in the study of the climate and the analysis of agro-climatic data.

514. **ADAPTATION AND ECOLOGY OF WORLD CROPS.**  
(3-0) Cr. 3. F.  
Prerequisite: 114, Bot. 310, Gen. 301, senior classification.  
Principles and concepts of origin, evolution, adaptation and ecology of world crops. Genetic and physiologic aspects of plant response to environment. Distribution of world crops on a climate basis.

518. **ADVANCED CROP PRODUCTION.**  
(3-0) Cr. 3. W.  
Prerequisite: 315 or 444. Woolley.  
Basic concepts in plant-soil-climate relationships with emphasis on recent advances in crop culture and management.

524. **PRINCIPLES OF PLANT BREEDING II.**  
(3-0) Cr. 3. W.  
Prerequisite: 424, Bot. 407. Atkins.  
Application of genetic principles to improvement of field crops. Topics covered include interspecific and intergeneric hybridization, induced polyploidy, induced mutations, sterilization mechanisms, character inheritance and specific breeding considerations related to a spectrum of crop species.

534. **PASTURE AND FORAGE RESEARCH METHODS.**  
(3-0) Cr. 3. Alt. W. offered 1973.  
Prerequisite: Stat. 401 and Agron. 434, or permission of instructor.  
Wedin.  
Research methods for pasture and forage intake-quality assessment in studies either dependent or independent of animal effects. Adaptation of methods to developing grassland situations. Analyses and interpretations of pasture and forage research results, with considerations of forage economics.

553. **SOIL-PLANT RELATIONSHIPS.**  
(3-0) Cr. 3. F.  
Prerequisite: 354. Black.  
Composition and properties of soils in relation to the nutrition and growth of plants.

558. **LABORATORY METHODS OF SOILS INVESTIGATIONS.**  
(0-4 to 6) Cr. 2 to 3. A: Alt. S, offered 1972; B: F.; C: W.  
A: Soil Microbiology and Biochemistry.  
B: Soil Chemistry.  
C: Soil Physics.  

561. **IRRIGATION AGRICULTURE.**  
(3-0) Cr. 3. Alt. S, offered 1972.  
Prerequisite: 354. Troeh.
Properties of soils in relation to irrigation; use and quality of irrigation water; reclamation of saline and sodic soils; soil-plant-water relationships; management of irrigated cropland; irrigation in humid regions.

565. ADVANCED SOIL MANAGEMENT AND CONSERVATION.
(3-0) Cr. 3. Alt. W. offered 1972.
Prerequisite: 364, 473, A.E. 306. Shreder.
Fundamental principles involved in the management, improvement, and conservation of soils.

575. SOIL MORPHOLOGY, GENESIS, AND CLASSIFICATION.
(3-0) Cr. 3. W.
Prerequisite: 473, 553. Fenton.
Morphology and formation of soils, systems of classification, and geographical distribution of soils.

577. SOIL PHYSICS.
(3-0) Cr. 3. F.
Prerequisite: 354, Math. 112 recommended. Kirkham.

COURSES FOR GRADUATE STUDENTS, major or minor

606. SEMINAR.
(1-0) Cr. 1. F.W.S.
Reports and discussions of recent literature and current investigations.
A. Crops. Carlson, Fehr, Hallauer.
B. Soils. Black.
C. Soil-Plant-Climate. Shaw.

609. AGRICULTURAL CLIMATOLOGY.
(0-1) Cr. 1. F.W.S.S. Shaw.
Consultation with instructor, special problems, and/or reports on reading assigned in consultations with the instructor.

615. ENVIRONMENTAL CROP PHYSIOLOGY.
(3-0) Cr. 3. S.
Prerequisite: Fundamental background in plant physiology and crop science. Shibbes.
The plant-environment interaction in relation to growth and production of crop communities.

620. COLLOQUIUM IN CROP PHYSIOLOGY.
(0-2) Cr. 1. W.
Prerequisite: Graduate classification and permission of instructor. Anderson, George, Pearce, Shibbes, Wedin, Woolley.
Presentation of papers and informal discussion of selected literature topics in crop physiology.

623. CYTogenetics IN PLANT BREEDING.
(3-0) Cr. 3. F.
Prerequisite: 524, Gen. 401, Bot. 605. Peterson.
Cytogenetics in plant breeding. Topics include chromosome recombination, principles of chromosome pairing, distribution of genetic materials, aberrations, polyplioids, genome relations, aneuploids, nullisomic analysis, and interspecific hybrids.

624. ADVANCED PLANT BREEDING I.
(3-0) Cr. 3. W.
Prerequisite: 524, Gen. 630. Russell.
Types of gene action in plant breeding. Topics include heritability, inbreeding depression and hybrid vigor, development and evaluation of parental materials, prediction of hybrid performance, procedures and problems in testing for general and specific combining ability, factors limiting efficiency of selection and testing.

625. ADVANCED PLANT BREEDING II.
(3-0) Cr. 3. S.
Prerequisite: 524, 624, Gen. 630. Frey.
Relation of physical properties of soils to plant growth. Particle-size distribution, soil structure, clay minerals, soil moisture, rheological properties, and soil temperature.

585. SOIL MICROBIOLOGY AND BIOCHEMISTRY.
(Bact. 585) (3-0) Cr. 3. W.
Prerequisite: 486. Frederick.
Nature of the microbiological population of the soil; activities of soil microorganisms, interactions between soil population and soil properties and plant growth; interpretation of biological data.

590. SPECIAL TOPICS.
Cr. arr.
Prerequisite: Fifteen credits in agronomy. Literature reviews and conferences on selected topics in crops, soils, or climatology according to needs and interest of student. For foreign students, an analysis of soil, climatic, and crop production resources of the student's home country is suggested.

655. ADVANCED SOIL FERTILITY.
(3-0) Cr. 3. Alt. W. offered 1973.
Prerequisite: 553. Black.
Evaluation of soil fertility and fertilizers; theory and applications.

657. SOIL CHEMISTRY.
(2-0) Cr. 2. Alt. 8, offered 1973.
Prerequisite: 553, Chem. 494 or equivalent. Scott.
Chemical and mineralogical properties of soil colloids. Ion exchange and soil reaction.

675. ADVANCED SOIL GENESIS AND CLASSIFICATION.
(0-2) Cr. 2. Alt. 8, offered 1972.
Prerequisite: 575. Riecken.
Processes, reactions, and theories in soil formation; principles of soil classification.

677. ADVANCED SOIL PHYSICS.
(3-0) Cr. 3. Alt. 8, offered 1973.
Prerequisite: 577, Math. 112, Math. 313 recommended. Kirkham.
The flow and distribution of water, gas, and heat in soils. Physical principles and applications.

685. ADVANCED SOIL BIOCHEMISTRY.
(3-0) Cr. 3. Alt. 8, offered 1972.
Prerequisite: 585. Bremner.
Nature of soil organic matter, and biochemical transformations brought about by soil microorganisms.

699. RESEARCH.
A. Agricultural Climatology.
B. Crop Production and Physiology.
C. Plant Breeding and Cytogenetics.
D. Soil Chemistry.
E. Soil Fertility.
F. Soil Management.
G. Soil Microbiology and Biochemistry (Bact. 699)
H. Soil Morphology and Genesis.
I. Soil Physics.
AIR FORCE AEROSPACE STUDIES

Col. Ronald L. Brumbaugh, B.S., Head of Department

Assistant Professors: Capt. John B. Larkins III, M.B.A.; Maj. Elmer G. Nelson, Jr., B.A.; Maj. Franklin E. Willis, M.A.

Undergraduate Study

The objective of Air Force Aerospace Studies is to provide officers commissioned as second lieutenants who are interested in careers in the Air Force.

The curriculum is divided into two two-year phases, the general military course (GMC) and the professional officer course (POC). Students may elect to substitute a 6-week field training period at an Air Force base for the GMC portion of the curriculum. Completion of the general military course either on campus or in the 6-week field training is a prerequisite for entry into the professional officers course. Cadets who complete the on-campus GMC classes are required to attend a 4-week field training period if they elect to enroll in the POC.

Cadets enrolling in the professional officer course must meet certain mental, physical, and moral standards. Qualified cadets may elect classification as flight candidates and receive flight instruction during their final year in the POC. Upon enrollment in the POC, all cadets are required to complete a contractual agreement with the Air Force, which obligates them to four years of active duty as an officer in the United States Air Force if in a nonflying category and six years if a pilot or navigator. Uniforms and texts are supplied to the cadets, and those in the POC receive a monthly subsistence allowance.

In addition, all cadets enrolled in the full four-year program may compete for an Air Force college scholarship which covers full tuition and fees plus a book allowance, and the monthly subsistence normally paid to POC cadets only. Cadets who have not completed or enrolled in the on-campus GMC classes are not eligible for the scholarship.

Additional information concerning Air Force Officer Education may be obtained from the Professor of Aerospace Studies, Iowa State University. Also see Officer Education, this catalog.

COURSES PRIMARILY FOR UNDERGRADUATE STUDENTS

141, 142, 143, 241, 242, 243. WORLD MILITARY SYSTEMS.
(1-0) Cr. 1 each. Yr.
Functions of U.S. military forces; defense organization and policy making; policies and strategies of Soviet Union and Communist China, and U.S. defense alliances.

141A, 142A, 143A, 241A, 242A, 243A. CORPS TRAINING.
(0-1) Cr. 8 each. Yr.
Initial military training related to wearing the uniform, engaging in military customs and courtesies, participating in military ceremonies, giving military commands and instruction, correcting and evaluating such skills, and learning the responsibility of an Air Force officer.

341, 342, 343. GROWTH AND DEVELOPMENT OF AEROSPACE POWER.
(3-0) Cr. 3 each. Yr.
Prerequisite: 243 or equivalent.
Aerospace power, astronautics, and space operations; probable developments in manned aircraft and space operations. Development of communication skills needed by junior officers.

341A, 342A, 343A, 441A, 442A, 443A. CORPS TRAINING.
(0-1) Cr. 8 each. Yr.
Advanced leadership training pertaining to planning, organizing, supervising, conducting, inspecting, and evaluating military activities; preparing and presenting briefings and other communications; providing counsel, guidance, information, and other services which increase the understanding, motivation, and performance of other cadets.

401. PRIMARY GROUND SCHOOL.
(3-0) Cr. 3. F.
Prerequisite: 343 or equivalent.
Theory of flight; Federal Aviation regulations; aviation meteorology; aerial navigation; flight computers; radio communications.

441, 442, 443. THE PROFESSIONAL OFFICER.
(3-0) Cr. 3 each. Yr.
Prerequisite: 343.
Professionalism, leadership, and management, including the meaning of professionalism, professional responsibilities, the military justice system, leadership theory, functions, and practices, management principles and functions, problem solving, and management tools, practices and controls.
ANIMAL SCIENCE

L. N. Hazel, Ph.D., Head of Department


Instructors: James L. Bergkamp, B.S.; James N. Glenn, B.S.; David B. Williams, M.S.

Undergraduate Study

For undergraduate curricula in animal science and dairy science, see College of Agriculture, Curricula.

The department offers the degrees Bachelor of Science in animal science, Bachelor of Science in dairy science, and complementary work toward admission to schools of law, medicine, and veterinary medicine in either curricula.

Graduate Study

The department offers work for the degrees Master of Science and Doctor of Philosophy in animal breeding, animal nutrition, meat science, muscle biology, nutritional physiology, physiology of reproduction, poultry breeding, poultry nutrition, and poultry products technology. Minor work is offered in these areas to students taking major work in other departments. For students desiring more general training than in the above specialized areas, the degree Master of Science is offered in animal production. In this program additional course work may be substituted for a thesis.

A strong undergraduate program is required for those students interested in graduate study. Fundamental training in biology, chemistry, mathematics, and statistics is prerequisite to a satisfactory graduate program. Graduate programs in animal science include supporting work in areas such as agronomy, anatomy, bacteriology, biochemistry, chemistry, economics, food technology, genetics, physiology, and statistics. Not infrequently, students choose graduate programs involving a joint major with one of these areas.

There is no foreign language requirement for the degree Master of Science. The foreign language requirement for the degree Doctor of Philosophy may be met by (a) obtaining a score of 460 or greater on the Educational Testing Service foreign language examination, or (b) passing one academic year of one foreign language (taken either as an undergraduate or graduate student) with a grade of C or better. In exceptional cases, the graduate committee may recommend that the requirements be changed to meet the needs of the individual candidate.

Open to graduate students for minor credit only: 318, 319, 350, 351, 420, 423, 425, 427, 429, 431, 434, 436, 437, 470.
COURSES PRIMARILY FOR UNDERGRADUATE STUDENTS

110. ORIENTATION IN ANIMAL SCIENCE.
(1-0) Cr. R; F.W.S.
Survey of animal science field.

114. ANIMAL PRODUCTION.
(3-4) Cr. 5; F.W.S.
Basic elements of the comparative characteristics and bodily functions of farm animals, their place in animal agriculture, and the production, evaluation, and marketing of their products. Includes cattle for meat and milk, horses, sheep, swine and poultry. Field trips.

115. LIGHT HORSES AND PONIES.
(2-3) Cr. 3; F.W.
Breeds of horses and ponies for work and pleasure. Selecting, judging, breeding, feeding, care, management, and marketing.

170. MEAT AND MEAT PROCESSING.
(2-2) Cr. 3; F.W.S.
Prerequisite: 114 or F.&N. 107.
Composition of meat and its nutritive value. Selection, grading, identifying, curing, and freezing meats.

218. FEEDS AND FEEDING.
(3-2) Cr. 4; W.
Prerequisite: 114.
Practical feeding and management of hogs, beef and dairy cattle, and sheep. Not accepted for credit for animal and dairy science degrees. A student may not count credit for both 218 and 319 toward a degree.

225. ANIMALS IN THE AMERICAN ECONOMY.
(3-2) Cr. 4; F.W.S.
The origin, development, and contribution of distinct animal types. Adapting animals to the changing needs of society.

271. MEAT ANIMAL EVALUATION.
(2-2) Cr. 3; F.W.S.
Prerequisite: 170, Chem. 231, sophomore standing.
Evaluation of meat animals, emphasizing growth and development and body composition. Grades and grading of meat.

301. POULTRY SCIENCE TECHNIQUES.
(1-3) Cr. 2; F.
Prerequisite: 114.
A laboratory course designed to supplement 114. Selection of breeding and laying stock, grading of eggs, premortem and postmortem grading of poultry, study of internal organs and their functions. Trips to nearby poultry farms.

305. LIVESTOCK JUDGING.
(0-8) Cr. 3; F.S.
Prerequisite: 271, 115 recommended. Warner. Beef cattle, hogs, sheep, and horses.

315. LIGHT HORSE HUSBANDRY.
(1-4) Cr. 3; F.S.SS.
Prerequisite: 115. Kiser.
Feeding, breeding, selection, care, handling, training, and marketing of light horses and ponies. English and Western equitation. Field trips.

318. FUNDAMENTALS OF NUTRITION.
(4-0) Cr. 4; F.W.S.SS.
Prerequisite: Organic chemistry; junior standing. Physiological recommended. Haynes, Young. Digestion and metabolism of carbohydrates, fats, proteins, minerals, and vitamins. Measures of energy.

319. APPLIED ANIMAL NUTRITION.
(3-0) Cr. 3; F.W.S.SS.
Prerequisite: 318. Foreman, Jurgens, Zimmerman.
Essential nutritive requirements of livestock and poultry, sources and composition of nutrients, replacement value of feeds in rations, identification of ingredients, ration formulation, and feeding recommendations. A student may not count credit for both 218 and 319 toward a degree.

335. DAIRY CATTLE SELECTION.
(0-6) Cr. 2; S.
Prerequisite: Sophomore standing. Wunder. Selection and breeding animals for dairy herds. Comparative terminology, decision making, and presentation of oral reasons. Trips to dairy cattle farms.

350. PRINCIPLES OF ANIMAL BREEDING.
(3-0) Cr. 3; F.W.S.SS.
Prerequisite: Gen. 301 or 350; Stat. 101. Wunder. The genetic and environmental bases of animal differences. Performance testing, selection, and mating systems.

361. APPLIED ANIMAL BREEDING.
(2-2) Cr. 3; F.W.S.SS.
Prerequisite: 350. Sims.
Application of quantitative genetic principles in evaluating seedstock. Methods of measuring and analyzing economic traits. Simulated breeding herd and flock selection.

370. MEAT MERCHANDISING AND MARKETING.
(3-3) Cr. 4; F.
Prerequisite: 371. Kline.

400. AGRICULTURAL TRAVEL COURSE.
Cr. 4; SS.
Prerequisite: Junior classification and or permission of instructor.
B. European Tour, offered 1972.
Students taking this course will also be required to register for Agron. 400 for 4 credits. Tour and study of production methods in major livestock and crop regions of the United States and other countries. Influence of climate, soil, topography, markets, and other factors on livestock and crops produced. Livestock management and crop production practices.

418. ANIMAL NUTRITION I.
(3-0) Cr. 3; F.
For students in veterinary medicine only. Nutrition requirements for maintenance, growth, fattening, reproduction, and lactation of ruminant and nonruminant animals, including small animals.

419. ANIMAL NUTRITION II.
(2-2) Cr. 3; W.
Prerequisite: 418.
Essential nutrient requirements of livestock and poultry. Sources and composition of nutrients; ration formulation and feeding practices.

420. POULTRY NUTRITION.
(3-2) Cr. 4; F.
Prerequisite: 318. Balloun.
Theoretical and practical aspects of poultry nutrition. Ration formulation, mixing, and feeding tests. Feeding programs and requirements at different ages.

423. POULTRY PRODUCTION.
(3-0) Cr. 3; F.
Prerequisite: Junior or senior standing or prevet. Practical feeding and management of chicken and turkey flocks. Operational study of commercial farms, including production and marketing practices.

427. **BEF PRODUCTION.** (4-0) Cr. 4. F.W.S. Alt. SSI, offered 1973. Prerequisite: 319, 350; 351 recommended. Breckelberg. The beef industry from conception to consumption. Cow-calf and feedlot operations.

429. **SHEEP PRODUCTION.** (3-0) Cr. 3. W.SSI. Prerequisite: 318, 350; 351 recommended. Warren. Calendarized farm flock program. Programs for feeder lambs. Wool.

431. **ANIMAL REPRODUCTION I.** (4-0) Cr. 4. F.W.S. Prerequisite: V. Phys. 264 or equivalent. Melamy. Comparative anatomy, physiology, and endocrinology of animal reproduction.


436. **DAIRY PROBLEMS.** (3-0) Cr. 3. W. Prerequisite: 350, 434. Porter. Seminar and discussion of current problems for the dairyman.

437. **MILK SECRETION.** (3-0) Cr. 3. F. Prerequisite: 318 or permission of instructor. Jacobson. Development, structure, and functional processes of the mammary gland. Nutritional relationships.

470. **MEAT SCIENCE.** (3-5) Cr. 4. F.S. Prerequisite: 170, Parrish. Structure and composition of skeletal muscle and connective tissue. Microbiology of meat. Post-mortem changes affecting meat and meat quality. Fundamentals involved in meat processing preservation. One-day field trip.


475. **INTERCOLLEGIATE JUDGING TRAINING AND COMPETITION.** A: Cr. 1 to 7. F.W.S; B: Cr. 1 to 6. F.W.S; C: Cr. 1 to 4. F.W.S; D: Cr. 1. W.S. Prerequisite: Permission of instructor. A. Meat Animals and Horses. B. Dairy Cattle. C. Meats. D. Marketing. Specialized training in evaluating and grading live animals and carcasses. Field trips to farms, meat packing firms, wool marketing warehouses, and livestock expositions.

490. **SPECIAL PROBLEMS.** Cr. 1 to 3. Prerequisite: Permission of instructor. Open to junior and senior students in animal science, dairy science, and home economics showing satisfactory preparation for problems chosen and with permission of instructor. Individual topic, conferences, and preparation of report. A. Animal Science. B. Dairy Science. C. Meats. D. Senior Seminar. G. Poultry Science. H. Honors Program.

**COURSES PRIMARILY FOR GRADUATE STUDENTS, major or minor, open to qualified undergraduates**

503. **SEMINAR IN ANIMAL PRODUCTION.** (1-0) Cr. 1. F.S. Discussion and evaluation of current topics in animal production and management.

506. **ANIMAL EXPERIMENTATION.** (3-2) Cr. 4. W. Prerequisite: Stat. 401. Christian. The scientific method in animal research. Recognizing and defining important problems in the livestock industry. Emphasis upon planning and conducting animal experiments and interpretation of the observed results.

518. **ADVANCED NONRUMINANT NUTRITION.** (2-0) Cr. 2. W. Prerequisite: 319. Speer. Nutrition requirements for maintenance, growth, fattening, reproduction, and lactation in the non-ruminant animal.

519. **ADVANCED RUMINANT NUTRITION I.** (3-0) Cr. 3. S. Prerequisite: 319. Burroughs. Digestion, absorption, and metabolism of nutrients as related to maintenance growth, lactation, and reproduction in ruminants.

520. **ADVANCED RUMINANT NUTRITION II.** (2-3) Cr. 3. Alt. F. offered 1972. Prerequisite: Permission of instructor. McGilliard. Survey of outstanding literature on methodology as applied to the study of the physiological aspects of ruminant nutrition. Laboratory to illustrate principles, methods, and special procedures.

531. **ANIMAL REPRODUCTION II.** (3-0) Cr. 3. F.S. Prerequisite: 431. Anderson. Endocrine aspects of animal reproduction.


COURSES FOR GRADUATE STUDENTS, major or minor

620. POPULATION GENETICS. (Gen. 650) (3-0) Cr. 3. B. Statistical methodology in the study of population genetics. Concepts of a population. Study of qualitative and quantitative population genetics including equilibrium and dynamic populations.

651. ADVANCED ANIMAL BREEDING I. (3-0) Cr. 3. W. Prerequisite: 650 or equivalent, Stat. 411. Freeman.

Methodology and statistical tools useful in animal breeding theory and application. Correction for environmental effects, estimation and interpretation of components of variance, heritabilities, genetic correlations, and their standard errors. Kinds of selection and selection index theory.

652. ADVANCED ANIMAL BREEDING II. (3-0) Cr. 3. F. Prerequisite: 651, Stat. 537. Hazel.


653. ADVANCED POULTRY BREEDING. (3-0) Cr. 3. Alt. S, offered 1972.
Prerequisite: 350. Nordskog.
Survey of poultry genetics. Application of systems of breeding to poultry, including inbreeding, outbreeding, hybridization, and methods of selection.

660. MODERN VIEWS OF NUTRITION. (F.A.N. 660) (2-0) Cr. R; W.
A seminar presenting current concepts in nutrition and related fields. Required for all graduate students in nutrition.

ANTHROPOLOGY

For description of courses, see Sociology.
APPLIED ART

Clair B. Watson, M.F.A., Head of Department

Professors: Harriet Adams, M.A.; Mary L. Meixner, M.A.; Janet L. Navin, M.S.
Associate Professors: Donna R. Danielson, M.S.; Gladys E. Hamlin, M.A.; Shirley E. Held, M.S.; Neva M. Petersen, M.S.

Undergraduate Study

For undergraduate curriculum in applied art leading to the degree Bachelor of Science, see Home Economics, Curricula.

The department offers work for the degree Bachelor of Science with majors in advertising design, art education, craft design, and interior design.

I. Advertising design. This major prepares students for positions in graphic design, for work requiring imagination and skills in the layout and design of communication media that will express concept and purpose with clarity and style.

II. Art education. This major is planned for students preparing for certification to teach art at the secondary level only, or in grades kindergarten through twelve. Students may enroll in art education, but to be admitted must apply and be accepted by a department committee and the Committee on Academic Standards of the College of Education. The programs outlined for art education are under the College of Home Economics, Department of Applied Art. For general requirements for teacher certification, see College of Education.

III. Craft design. This major provides a broad background in crafts with a strong emphasis in two craft media. The student is prepared to operate a shop or market crafts, to engage in freelance design, to work in an organizational capacity in community or welfare workshops, or to become a teacher in public or private adult education.

IV. Interior design. This major is planned for art students who enter the professional field of interior design and decoration.

Students applying for advanced credit must submit representative work.

Courses open for satisfactory-fail program: Students outside the Applied Art Department may enroll in any course in the department on a satisfactory-fail basis.

Graduate Study

The department offers work for the degree Master of Arts with majors in advertising design, art education, craft design, and interior design. Students taking major work in other departments may take minor work in applied art.

Prerequisite to major graduate work is the completion of undergraduate work in applied art substantially equivalent to that required in the undergraduate curriculum in applied art at this institution.

There is no foreign language requirement for the degree Master of Arts.

For students interested in interdisciplinary study of housing, a program is administered in cooperation with the departments of Applied Art, Architecture, Family Environment, and Landscape Architecture. For details, consult the head of the department.

Open to graduate students for minor only: 433, 446, 467, 468, 474, 484, 490.
COURSES PRIMARILY FOR UNDERGRADUATE STUDENTS

100. PERSPECTIVE DRAWING.
(0-6) Cr. 2. F.W.S.SS.
Use of drawing instruments for scale and measured drawing in relation to applied art.

103. 104. DESIGN.
103: (2-6) Cr. 4; 104: (0-9) Cr. 3. F.W.S.SSI.
Prerequisite: 103.
103: Creative problems in design and color with emphasis on art elements and principles.
104: Two- and three-dimensional forms in design; varied materials and techniques.

150. DRAWING.
(0-9) Cr. 3. F.W.S.SS.
Introduction to drawing and composition in black and white media to develop figurative and non-figurative expression.

170. LETTERING.
(0-9) Cr. 3. F.W.S.
Classic, traditional, and modern letter forms.

200. ART FOR THE ELEMENTARY SCHOOL.
(1-6) Cr. 3. F.S.
Experiential work in two and three dimensions suitable for the teaching of arts and crafts in the elementary school.

203. COLOR.
(1-4) Cr. 3. F.W.S.
Prerequisite: 103.
Color theory and problems to develop awareness of color interaction, sensation, and light.

233. WATERCOLOR.
(0-9) Cr. 3. F.W.S.SSI.
Prerequisite: 150.
Varied methods of watercolor painting and their relationship to interpretation, color, and composition.

244. 245. WEAVING.
(0-9) Cr. 3 each. F.W.S.SSI.
Prerequisite: 244: 103; 245: 203, 244.
244: Fundamentals of weaving. Use of table looms and nonloom processes.
245: Applied weaving with emphasis on designing for specific, useful, or decorative fabrics.

247. DESIGN IN METAL AND ENAMEL.
(0-9) Cr. 3. F.W.S.SSI.
Prerequisite: 100, 103.
Design and manipulation of copper, brass, and pewter and the application of basic enamel processes.

250. INTERMEDIATE DRAWING.
(0-9) Cr. 3. F.W.S.SSI.
Prerequisite: 150.
Advanced study in drawing techniques and experimental media with emphasis on drawing as an art form.

261. 262. FUNDAMENTALS OF INTERIOR DESIGN.
261: (1-4) Cr. 3. F.W.S.SSI; 262: (0-9) Cr. 3. S.
Prerequisite: 261: 103; 262: 261.
261: Principles of design and color applied to the exterior, interior, and furnishings of the house.
262: Problems in design and color in the interior; analysis of home furnishings and house design. For nonmajors only.

264. INTERIOR SKETCHING.
(0-9) Cr. 3. F.W.
Prerequisite: 233.
Varied techniques in rendering interiors.

270. LETTERING FOR GRAPHICS.
(0-9) Cr. 3. F.W.
Prerequisite: 103, 170.
Advanced problems in letter design, application, and technique.

272. TYPOGRAPHY.
(0-9) Cr. 3. W.S.
Prerequisite: 270.
Type and its application in graphic layout.

278, 279. FASHION ILLUSTRATION.
278: (0-9) Cr. 3. F.W.S.; 279: (0-9) Cr. 3. S.
Prerequisite: 278: 150; 279: 278.
Illustration of the fashion figure, costume rendering, layout.

290. SPECIAL PROBLEMS.
Cr. arr.
Prerequisite: Permission of the instructor.

300. STUDY TOUR.
Cr. R; S.
Prerequisite: Applied art junior classification.
Study tour to professional studios, retail establishments, art museums.

301, 302, 303. HISTORY OF ART.
(3-0) Cr. each.
301: F.W; 302: W.S; 303: F.S.
Prerequisite: 301: 301; 303: 302.
Styles of architecture, painting, and sculpture from prehistoric times to the present, emphasizing artists and their works in the cultures that produced them.

310. COLLOQUIUM.
Cr. 1 or arr.
Prerequisite: Twelve credits in applied art.
Art discussion.

333. OIL PAINTING.
(0-9) Cr. 3. F.W.S.
Prerequisite: 233, 250.
Introduction to oil painting and new media.

340. CERAMICS.
(0-9) Cr. 3. F.W.S.SSI.
Prerequisite: 104.
Introduction to clay: construction, decoration, and firing.

345. DESIGN IN WOOD.
(0-9) Cr. 3. F.W.S.SSI.
Prerequisite: 100, 104.
Design and construction in wood with orientation to basic woodworking equipment.

347, 348. TEXTILE DESIGN.
347: (1-9) Cr. 4. F.W.S.SSI; 348: (0-9) Cr. 3. F.W.S.SSI.
Prerequisite: 347: 103; 348: 203, 347.
347: Creative design in block print, stencil, stitchery, batik and silk screen. Comparative analysis of designers and processes.
348: Varied media in textile design.

350. LIFE DRAWING.
(0-9) Cr. 3. F.W.S.
Prerequisite: 250.
Artistic anatomy, drawing from the model, and portrait in various media.

361, 362. HISTORY OF FURNITURE.
(3-0) Cr. each.
361: F; 362: W.
361: European furniture styles and interior architectural backgrounds.
362: American furniture styles and interior architectural backgrounds.

364, 365. INTERIOR DESIGN.
(0-9) Cr. each.
364: F.W.; 365: W.S.
Prerequisite: 364: 261, 264; 365: 364.
Professional presentation of theoretical problems in domestic interiors.

370, 371. ADVERTISING DESIGN.
(0-9) Cr. each.
370: F.W.S.SSI; 371: F.S.
Prerequisite: 370: 170; 371: 370.
Graphic layout and design for visual communication through problems in magazine, letterhead, poster, and packaging.

373. GRAPHIC ART PRODUCTION.
(0-9) Cr. 3. W.S.
Prerequisite: 370.
Printed production methods and processes. Experiences involving professional studio practices required for each process.

384. SURVEY OF ART.
(3-0) Cr. 3. F.W.S.SSI.
Prerequisite: Junior standing.
Survey of the art of all ages, emphasizing art as an expression of cultures.

415. ART METHODS FOR THE ELEMENTARY SCHOOL.
(0-9) Cr. 3. F.
Prerequisite: Admission to teacher education program.
Development of a basic philosophy for art education and a study of methods and media for teaching art in the elementary school.

416. ART METHODS FOR THE SECONDARY SCHOOL.
(0-9) Cr. 3. W.
Prerequisite: Admission to teacher education program, Educ. 305A, 305B.
Development of a basic philosophy of art education and study of methods and media for teaching art in the high school.

417. SUPERVISED TEACHING OF ART IN THE SECONDARY SCHOOL.
Cr. 8 to 9. F.S.
Prerequisite: All courses in the art education curriculum.
Supervised teaching in public schools. Advance reservation required.

418. SUPERVISED TEACHING OF ART IN THE ELEMENTARY SCHOOL.
Cr. 8. F.S.
Prerequisite: All courses in the art education curriculum.
Supervised teaching at the elementary school level.

433. ADVANCED PAINTING.
(0-9) Cr. 3. W.S.
Prerequisite: 333.
Emphasis on experimentation in painting.

446. JEWELRY.
(0-9) Cr. 3. F.W.S.SSI.
Prerequisite: 247.
Jewelry design.

466. APPRENTICESHIP.
Cr. 9. SSI following the junior year.
Prerequisites: 301, 347, 361, 365.
Practical interior design shop experience.

467. COMMERCIAL INTERIOR DESIGN.
(1-6) Cr. 3. F.S.
Prerequisite: 365.
Advanced decorative planning; commercial and contract problems.

468. PROFESSIONAL INTERIOR DESIGN PROCEDURES.
(2-0) Cr. 2. F.
Prerequisites: Credit or classification in 467. Written specifications; cost of materials and general procedures for interior designers.

474. ILLUSTRATION FOR ADVERTISING.
(0-9) Cr. 3. W.S.
Prerequisite: 370.
Proficiency in media usage. Techniques and styles for illustration.

484. HISTORY OF ORNAMENT.
(3-0) Cr. 3. S.
A study of historic ornament with emphasis on the arts of the past and their application to the present.

490. SPECIAL PROBLEMS.
Cr. 2 to 3.
Prerequisite: Existing course offerings, reservation, and permission of instructor.
A. Painting and Composition.
B. Textile Design.
C. Weaving.
D. Ceramics.
E. Interior Design.
F. Advertising Design.
G. Fashion Illustration.
H. Honors.
J. Jewelry.
K. Design in Wood.
L. Design in Metal and Enamel.
M. Art Education.

COURSES PRIMARILY FOR GRADUATE STUDENTS, major or minor, open to qualified undergraduates

500. SHORT COURSE.
Cr. arr. SSI.
Prerequisite: Permission of instructor.

COURSES FOR GRADUATE STUDENTS, major or minor

590. SPECIAL TOPICS.
Cr. arr. F.W.S.SSI.
Prerequisite: Bachelor's degree in applied art or satisfactory evidence of ability.
A. Painting and Composition.
B. Textile Design.
C. Weaving.
D. Ceramics.
E. Interior Design.
F. Advertising Design.
G. Fashion Illustration.
J. Jewelry.
K. Design in Wood.
L. Design in Metal and Enamel.
M. Art Education.

605. SEMINAR.
Cr. arr. F.W.S.

699. RESEARCH.
ARCHITECTURE

Martin D. Gehner, M.Arch., Head of Department

Professors: Karol J. Kocimski, M.Arch.; Lawton M. Patten, B.Arch.; Raymond D. Reed, M.Arch.; Vernon F. Stone, B.Arch.


Instructor: Paul Shao, M.F.A.

Undergraduate Study

For curriculum in architecture leading to the degrees Bachelor of Arts and Master of Architecture, see College of Engineering, Curricula.

The architect seeks to shape an environment that encourages the growth of human values. The curriculum in architecture provides the academic foundation for a professional career in architecture. The first two years of the program provide a liberal basis for literate studies. The second two years develop the technical vocabulary to permit expression as an architect. Electives and professional electives encourage individuals to study in depth those areas in which they possess unique interests and aptitudes. The degree Bachelor of Arts is awarded upon successful completion of the four-year program.

Graduate Study

The department offers major work for the degree Master of Architecture. The master's program is designed to educate professional architects to work effectively within contemporary constraints, to comprehend continuing changes within our society, and to formulate concepts for a better human environment. Individual study in areas relevant to architecture is encouraged.

Students possessing the degree Bachelor of Arts in architecture should receive the degree Master of Architecture upon successful completion of a minimum of 90 credits of approved graduate studies. Students possessing the five-year degree Bachelor of Architecture should receive the degree Master of Architecture upon successful completion of a minimum of 45 credits of approved graduate studies. A minimum of one academic year of full-time graduate study must be spent in residence at Iowa State University.

There is no foreign language requirement for the degree Master of Architecture.

For students interested in interdisciplinary study of housing, a program is administered in cooperation with the departments of Applied Art, Architecture, Family Environment, and Landscape Architecture. For details consult the head of the department.

Open to graduate students for minor credit only: Arch. 321, 322, 323, 361, 362, 363, 430, 444, 446, 447.

COURSES PRIMARILY FOR UNDERGRADUATE STUDENTS

101. ORIENTATION. (3-0) Cr. 3. F.W.S.S.
Synthesis, orientation, seminar discussions and lectures, field trips, visiting critics, projects of timely interest, and computation methods.

238, 239. FREEHAND DRAWING I. (0-9) Cr. 3 each. 238: F.W.S.S; 239: W.S.S.
Prerequisite: 238; 239.
Monochromatic media. Basic drawing tools and exercises, fundamental work habits, observation, perception, visualization, and expression.

314, 315, 316. DESIGN I. (0-12) Cr. 4 each. Yr.
Prerequisite: 314; credit or classification in E.Gr. 341; 315: credit or classification in E.Gr. 342; 316: credit or classification in E.Gr. 343.
Introduction of factors shaping the human physical environment. Projects in architectural design, integration of systems, and problem-solving procedures. Field trips.
COURSES FOR
611, 612, 613. RESEARCH AND DESIGN IV.
Prerequisite: 515, 516.
A survey of architecture and the related arts from early western civilization to the modern movement. Architecture as an expression of environment and of social conditions and values is stressed.

341, 342, 343. ARCHITECTURAL TECHNOLOGIES I.
Prerequisite: 341: Phys. 111; 342: 341; 343: 342.

361. RESIDENTIAL ARCHITECTURE I.
Prerequisite: 361.
Principles of planning and design of houses with consideration given to site selection, financing, planning, equipment, materials, and methods of construction.

362. RESIDENTIAL ARCHITECTURE II.
Prerequisite: 361.
Principles of planning and design of individual unit housing with consideration given to the social, economic and political factors.

363. HOUSING.
Prerequisite: 362.
Principles of planning and design of group or multiple housing with consideration given to the social, economic, and political factors.

414, 415, 416. DESIGN II.
Prerequisite: 415.
Architectural projects of intermediate scope. Economic, technical, and sociometric variables. Recognition and synthesis of subjective and objective values. Field trips.

430. FREEHAND DRAWING II.
Prerequisite: 341.
Field trips.

431, 432, 433. ARCHITECTURAL DELINEATION.
Prerequisite: 431.
Principles of freehand drawing. Methods, media, techniques of visual communication. Drawings and models.

444, 446, 447. ARCHITECTURAL TECHNOLOGIES II.
Prerequisite: 444.

490. SPECIAL PROBLEMS IN ARCHITECTURE.
Prerequisite: Written approval of instructor and department head.
Investigation of problems of special interest to the student. H. Honors.

COURSES PRIMARILY FOR GRADUATE STUDENTS, major or minor, open to qualified undergraduates

500. ARCHITECTURAL INTERNSHIP.
Prerequisite: 500.
A one-year cooperative program with an approved architecturally oriented industry or business.

501, 502, 503. SEMINAR.
Prerequisite: Classification in 514, 515, 516 respectively.
Synthesis, professional orientation, seminar discussion and lectures. Field trips, visiting critics, projects of timely interest.

514, 515, 516. RESEARCH AND DESIGN III.
Prerequisite: 416 or equivalent.
Complex urban architectural design problems. Field trips.

521, 522, 523. HISTORY OF ARCHITECTURE II.
Prerequisite: 522.
A study of architecture and the related arts since the development of the modern movement. Architecture as an expression of environment, social conditions and values.

532. TWO-DIMENSIONAL DESIGN.
Prerequisite: Six credits in freehand drawing. Exploration in the use of expressive forms and spaces through color, value, and textural relationships via the two-dimensional idiom, primarily in the medium of acrylic and oil paints.

533. THREE-DIMENSIONAL DESIGN.
Prerequisite: Six credits in freehand drawing. Approved student-selected projects. Investigation of contemporary sculptural media.

543. OFFICE PRACTICE.
Prerequisite: 543.
Contract documents, office procedure, and administration.

590. SPECIAL TOPICS.
Prerequisite: Written approval of instructor and department head.

COURSES FOR GRADUATE STUDENTS, major or minor

611, 612, 613. RESEARCH AND DESIGN IV.
Prerequisite: 515.
Individual and group solutions to large scale architectural problems of complex, multiple or specialized requirements. Student competitions. Field trips.

681, 682, 683. THEORY OF URBAN ARCHITECTURE.
Prerequisite: 523.
History, theory, and problems relating to the determinants of urban architecture.
BACTERIOLOGY

William R. Lockhart, Ph.D., Chairman of Department

Professors: Lloyd R. Frederick, Ph.D.; Paul A. Hartman, Ph.D.; Peter A. Pattee, Ph.D.; Loyd Y. Quinn, Ph.D.; George W. Reinbold, Ph.D.; Homer W. Walker, Ph.D.

Associate Professors: Donald P. Durand, Ph.D.; John G. Holt, Ph.D.; Fred D. Williams, Ph.D.

Undergraduate Study

For undergraduate curriculum in sciences and humanities, major in bacteriology, leading to the degree Bachelor of Science, see Sciences and Humanities, Curriculum.

In this department, principal emphasis is placed on understanding the interrelationships of bacteria in nature, the application of bacteriology in agriculture and industry, and the study of fundamental life processes using bacteria as primitive examples of living things. Varied careers are open to qualified graduates: in hospital and clinical laboratories, in federal, state, or local government organizations and in research and development and quality-control laboratories maintained by the dairy and food processing, pharmaceutical, and fermentation industries, among others. Some fields of bacteriology, especially advanced research, may require further training. Undergraduate work in the department is designed to provide sound preparation for graduate study.

Undergraduate programs usually include the following basic courses: 300, 320, 330, 340, and 490. The following courses are desirable as supporting work: Chem. 211, 334, 335, 336; Phys. 111, 112, 113; Math. 110; Stat. 101; Biol. 101, 101A, 103, 106, 107; Gen. 301. These lists of courses are neither fixed requirements nor complete outlines of the work necessary for the major but are intended as a guide for students and advisers in planning individual programs.

Graduate Study

The department offers work for the degrees Master of Science and Doctor of Philosophy with major in bacteriology. Within the major the student may specialize in pathogenic bacteriology and immunology, food and sanitary bacteriology, agricultural and industrial microbiology, physiology and genetics of bacteria, virology, and systematic bacteriology. Major graduate study in veterinary bacteriology, soil bacteriology, and dairy bacteriology is offered in the departments of Veterinary Hygiene, Agronomy, and Food Technology, respectively.

Specific prerequisite to major work in bacteriology is the completion of thorough courses in general bacteriology, biology, organic chemistry, and physics. Biochemistry, physical chemistry, and mathematics are advised. Minor study usually is selected from chemistry, biochemistry and biophysics, botany, zoology, genetics, mathematics and statistics.

Major and minor work in the area of cell biology is offered under a cooperative arrangement with the departments of Bacteriology, Biochemistry and Biophysics, Botany and Plant Pathology, Genetics, and Zoology and Entomology. See Cell Biology.

Candidates for the M.S. degree must demonstrate their ability to translate scientific articles from either French, German, or Russian, and Ph.D. candidates must demonstrate ability to translate material from two of the foregoing languages. Language examinations are administered by the department. Before the first such examination, a student must either have completed two years of formal study of the language in question, with grades averaging at least B, or earn a score of at least 400 in the Educational Testing Service Foreign Language Examination. Ordinarily this requirement will be satisfied before enrollment in the Graduate College. The manner in which the requirement for the second language is met may vary according to the needs of the individual student.

Open to graduate students for minor only: 412, 413, 414, 450, 485.
COURSES PRIMARILY FOR UNDERGRADUATE STUDENTS

300. **INTRODUCTORY BACTERIOLOGY.**
(Biol. 300) (3-6) Cr. 5. F.W.S.S.
Prerequisite: Biol. 101A; Chem. 231 or 334.
Study and cultivation of bacteria; laboratory methods in bacteriology.

320. **MICROBIAL DIVERSITY.**
(3-6) Cr. 5. F.
Prerequisite: 300.
Survey of the microbe world; study, isolation, and cultivation of the major groups of bacteria; principles of bacterial taxonomy.

330. **PATHOGENIC BACTERIA.**
(3-6) Cr. 5. W.
Prerequisite: 300.
Study of pathogenic bacteria by clinical laboratory techniques, serological methods, tissue cell culture.

340. **BACTERIAL PHYSIOLOGY.**
(3-6) Cr. 5. S.
Prerequisite: 300.
Structure and function of bacteria, introduction to bacterial metabolism and genetics.

COURSES PRIMARILY FOR GRADUATE QUALIFIED UNDERGRADUATES

509. **GENERAL VIROLOGY.**
(Bot. 509, V. Micr. 509) (3-6) Cr. 5. F.
Prerequisite: Permission of instructor.
Bacterial, plant, and animal viruses with special reference to morphology, physical-chemical properties, multiplication, and host responses.

525. **APPLIED MICROBIOLOGY.**
(3-0) Cr. 3. F.
Prerequisite: 509.
Utilization of microorganisms in agriculture and industry.

COURSES FOR GRADUATE STUDENTS, MAJOR OR MINOR

601, 602, 603. **ADVANCED BACTERIOLOGY.**
(3-6) Cr. 5 each. Yr.
Prerequisite: 601: Permission of instructor; 602: 601; 603: 602.
601: Bacterial nutrition; metabolic and genetic control of cell function; influence of physical and chemical environment on bacteria. 602: Metabolism, biosynthetic and catabolic pathways; methods for study of metabolic pathways. 603: Morphology and cytology of the major groups of bacteria; principles governing the classification of bacteria.

610. **SPECIAL TOPICS.**
Cr. 2 to 5.
Prerequisite: Permission of instructor. Selected topics of current interest.

615. **MOLECULAR VIROLOGY.**
(3-6) Cr. 5. S.
Prerequisite: 509 or 608.
Structure, function, and genetics of viruses and virus-like agents; host-virus interactions.

620. **MOLECULAR GENETICS.**
(Gen. 620) See Genetics.

621. **BACTERIAL GENETICS.**
(Gen. 621) (3-6) Cr. 5. F.
Prerequisite: 603.
Isolation, characterization, and use of mutant bacteria; mechanisms of genetic exchange and their application to genetic and biochemical analysis of bacteria.

COURSES FOR GRADUATE STUDENTS, MAJOR OR MINOR

645. **BACTERIAL CYTOLOGY.**
Prerequisite: 603.
Theory of structure and function of the bacterial cell; methods in microscopy of bacteria.

650. **SYSTEMATIC BACTERIOLOGY.**
Prerequisite: 603.
Theory of classification; applications of molecular and numerical data; principles of bacteriological nomenclature.

675. **ADVANCED IMMUNOLOGY.**
Prerequisite: 675.
Principles and methods of immunobiology, immunogenetics, and immunocytology.

678. **TISSUE CELL CULTURE RESPONSES TO PATHOGENS.**
(3-6) Cr. 5. Alt. F, offered 1971.
Prerequisite: 603.
Methods for tissue cell culture propagation; measurement of tissue cell culture metabolism; comparison of pathogen-free and infected cultures.

698. **SEMINAR IN CELL BIOLOGY.**

699. **RESEARCH.**
BIOCHEMISTRY AND BIOPHYSICS

Dexter French, Ph.D., Chairman of Department

Professors: Jon B. Applequist, Ph.D.; Emerson W. Bird, Ph.D.; Herbert J. Fromm, Ph.D.; Darrel E. Goll, Ph.D.; Donald J. Graves, Ph.D.; David E. Metzler, Ph.D.; Harry E. Snyder, Ph.D.; Byron H. Thomas, Ph.D.


Assistant Professors: Alan G. Atherly, Ph.D.; Donald C. Beitz, Ph.D.; Roger L. Heintz, Ph.D.; John F. Robyt, Ph.D.; Chuen-Mo To, Ph.D.; Bernard J. White, Ph.D.

Undergraduate Study

For the undergraduate curriculum in sciences and humanities with a major in biochemistry or biophysics leading to the degree Bachelor of Science, see Sciences and Humanities, Curriculum.

Biochemists and biophysicists seek to understand life processes in terms of chemical and physical principles. They are employed wherever a better understanding of living organisms is sought, whether it be in the production of antibiotics or vitamins in a fermentation industry, in investigation of nutritional requirements of plants or animals, or in the study of the functions of the human body in health and disease. While there are many opportunities in universities and medical schools, government laboratories, and industry for both men and women well trained in biochemistry or biophysics, students who meet the necessary high scholastic standards usually continue their studies in a graduate college. The undergraduate programs in biochemistry and biophysics are designed to provide sound preparation for graduate work leading to the doctorate.

Undergraduate biochemists usually have the following basic courses or their equivalents in their programs: B.&B. 101, 102, 103, 201, 401 (or 501, 502, 503), 461, 511; Chem. 114, 115, 120, 224, 325, 326, 327, 330, 331, 332, 333; Math. 110, 111, 112, 213; Phys. 221, 222, 223; Biol. 101, 101A, 103; Zool. 106 and 455, or C.Bio. 428, or Bot. 107, 310; Bact. 300; Gen. 350.

Biophysicists usually include the following basic courses in their programs: B.&B. 101, 102, 103, 461; Chem. 114, 115, 120, 321, 322, 323, 331, 332, 333; Math. 110, 111, 112, 213, 321, 322, 409, 410; Phys. 221, 222, 223, 311, 421, 422, 423; Biol. 101, 101A, 103; Zool. 106, and 455 or C.Bio. 428, or Bot. 107, 310.

These lists of courses should not be regarded as statements of fixed requirements or as complete outlines of the work necessary for the major. They are given solely for the convenience of students or advisers who wish to estimate the amount of basic study which may be needed.

Graduate Study

The department offers work for the degrees Master of Science and Doctor of Philosophy with majors in biochemistry and in biophysics and minor work to students taking major work in other departments.

Major and minor work in the area of cell biology is offered under a cooperative arrangement with the departments of Bacteriology, Biochemistry and Biophysics, Botany and Plant Pathology, Genetics, and Zoology and Entomology. See Cell Biology.

Prerequisite to graduate work is completion of sufficient undergraduate work in chemistry, mathematics, physics, and biology.

There is no foreign language requirement for the degree Master of Science. Candidates for the degree Doctor of Philosophy must demonstrate a reading knowledge of one foreign language, chosen from French, German, or Russian, by passing (50th percentile or better) the Educational Testing Service examination. A foreign student whose native language is Chinese, French, German, Italian, Japanese, Russian, or Spanish may be excused from the foreign language examination.

Open to graduate students for minor only: 304, 305, 401, 404, 405, 406, 461, 490.
COURSES PRIMARILY FOR UNDERGRADUATE STUDENTS

101. INTRODUCTION TO BIOCHEMISTRY.  (2-0) Cr. 2. F.
Fundamentals of biochemistry including structures of biopolymers, fundamentals of biocatalysis and metabolism. Open only to majors in biochemistry and biophysics.

102, 103. INTRODUCTION TO BIOCHEMICAL ACTIVITIES.  
(1-0) Cr. 1 each; 102: W; 103: S.
Prerequisite: 101.
Research activities and career opportunities in biochemistry.

201. THE CHEMISTRY OF LIFE.  (3-0) Cr. 3. S.
Prerequisite: Two quarters of organic chemistry.
Chemical basis of selected aspects of enzymology, metabolism, and genetics. Designed for sophomore majors in biochemistry and biophysics; open to others desiring a sophisticated introduction to biochemistry.

301. SURVEY OF BIOCHEMISTRY.  (5-0) Cr. 3. F.W.S.S.
Prerequisite: Fundamental ideas and methods for students in biology, agriculture, and home economics, emphasizing intermediary metabolism and the biochemistry of higher organisms.
304, 305. PHYSIOLOGICAL CHEMISTRY.  
(3-0) Cr. 3 each; 304: F; 305: W.  
Prerequisite: Courses in organic chemistry.  
Includes chemical basis of biological catalysis; metabolism; the biochemistry of genetics. Not accepted for credit toward a chemistry, biochemistry, or biophysics major.

304, 305. PHYSIOLOGICAL CHEMISTRY.  
(3-0) Cr. 3 each; 304: F; 305: W.  
Prerequisite: Chem. 335.
304: Chemistry of the animal body; digestion; absorption. 305: Metabolism of carbohydrates, lipids, proteins, and minerals.
Must be accompanied by 314 and 315 for veterinary medicine students. Not accepted for credit toward a chemistry, biochemistry, or biophysics major.

311. LABORATORY IN BIOCHEMISTRY.  
(0-8) Cr. 2. F.W.S.
To accompany 301. Not accepted for credit toward a chemistry, biochemistry, or biophysics major.

314, 315. LABORATORY IN PHYSIOLOGICAL CHEMISTRY.  
(1-3) Cr. 2 each; 314: F; 315: W.  
Prerequisite: 314: freshman standing in College of Veterinary Medicine; 316: 314.

To accompany B.&B. 304, 305 and V.Phys. 314, 315. Not accepted for credit toward a chemistry, biochemistry, or biophysics major.

401. PRINCIPLES OF BIOCHEMISTRY.  
(4-0) Cr. 4. S.
Prerequisite: Classification or credit in Chem 333 or 336; Phys. 113 or 223.
A qualitative but rigorous introduction to biochemistry, with emphasis on the cellular and subcellular aspects. Topics include: energy transformations, metabolism, biopolymers, enzymes, organelles, and regulatory mechanisms. For undergraduate physical, biological, or engineering science majors.

404, 405, 406. BIOCHEMISTRY.  
(3-0) Cr. 3 each. Yr.
Prerequisite: Chem. 336 or equivalent; Chem. 336 recommended.
A general biochemistry course intended primarily for students in biology, agriculture, and home economics. Emphasizing intermediary metabolism and the biochemistry of higher organisms.
404 and 405: Catalysis, bioenergetics, chemistry of biological membranes, intermediary metabolism and synthesis of biopolymers. 406: Metabolism of differentiated cells; membranes and cell walls; biosynthesis of heme, porphyrins and other prosthetic groups, cofactors and vitamins; and other topics.

461. INTRODUCTION TO BIOPHYSICS.  
(3-0) Cr. 3. F.
Prerequisite: Chem. 115 or 142 or 148, Phys. 113 or 223.
Ideas and methods used in biophysics to attack fundamental biological problems. A study of several currently active research areas such as molecular genetics, contractility, nerve conduction and vision.

490. SPECIAL PROBLEMS.  
Cr. arr.
H. Honors Program.

499. UNDERGRADUATE RESEARCH.  
Cr. 2 to 6 each time taken.
Prerequisite: Permission of staff member with whom student proposes to work. B average in all previous courses.
Literature survey and research under senior staff guidance.

COURSES PRIMARILY FOR GRADUATE STUDENTS, major or minor, open to qualified undergraduates

501, 502, 503. GENERAL BIOCHEMISTRY.  
(4-0) Cr. 4 each. Yr.
Prerequisite: Courses in analytical chemistry, organic chemistry (Chem. 333 or 335) and physical chemistry (Chem. 322 or 325 or 494). Concurrent enrollment in physical chemistry may be permitted with consent of instructor.
Chemical composition of living matter and the chemistry of life processes. For graduate students in biochemistry and biophysics, and advanced undergraduates in chemistry and for other qualified students desiring a rigorous course.

511, 512. LABORATORY IN GENERAL BIOCHEMISTRY.  
(1-8) Cr. 3 each; 511: F; 512: W.
Prerequisite: 511: 401 or 405 or 501 or concurrent registration in 501; 512: 511.
Modern techniques of biochemical research.

521. RADIOBIOCHEMISTRY.  
(1-6) Cr. 3. W.S.
Prerequisite: Chem. 426, permission of instructor. Heintz, White.
A laboratory course in the use of radioactive isotopes in biochemistry; dilution techniques, isolation of metabolites, elucidation of reaction mechanisms, and metabolic pathways.

527, 528. ADVANCED CELL BIOLOGY.  

561, 562. BIOPHYSICAL METHODS.  
(3-0) Cr. 3 each; 561: W; 562: S.
Prerequisite: Fundamental training in biology, physics, or mathematics, permission of instructor. Fou, Rougvie.
Optical techniques: spectroscopy and spectrophotometry, birefringence, optical rotation, light scattering, etc. Methods for the study of macromolecules: viscosity, diffusion, ultracentrifugation, electrophoresis, X-ray diffraction.

571, 572. LABORATORY IN BIOPHYSICS.  
(0-6) Cr. 2 each; 571: W; 572: S.
Prerequisite: Permission of Instructor. Fou, Rougvie.
To accompany 561, 562.
298 Courses and Programs

574. MICROSCOPY.  (3-0) Cr. 3. S.
Prerequisite: Permission of instructor. Outka, To.
Optical microscopy including phase and interference techniques. Principles of electron optics. Methods and applications of electron microscopy.

575. LABORATORY IN MICROSCOPY.  (0-6) Cr. 2.
Prerequisite: Credit or classification in 574. Outka, To.

COURSES FOR GRADUATE STUDENTS, major or minor

601. ADVANCED BIOCHEMISTRY.  (2-0) Cr. 2 each time taken. F.W.S.
Prerequisite: 501, permission of instructor.
A series of one term courses covering topics such as enzymes, hormones, lipids, nucleic acids, proteins, vitamins, biochemistry of diseases, immunology, and biochemical methods.

602. CARBOHYDRATE CHEMISTRY.  (3-0) Cr. 3. S.S. French.
Prerequisite: Permission of instructor.
Chemical behavior and enzymic relationships of sugars and polysaccharides.

*B22. CARBOHYDRATE CHEMISTRY.  (3-0) Cr. 3. S.S. French.
Prerequisite: Permission of instructor.
Chemical behavior and enzymic relationships of sugars and polysaccharides.

581, 582. SEMINAR.  (1-0) Cr. 1 each. 581: F; 582: W.
Prerequisite: Permission of instructor.
Short talks and discussion by students on assigned topics. For entering graduate students and qualified seniors.

590. SPECIAL TOPICS.  Cr. arr.

BIOLOGY

Advisory Committee: Robert Franke, Ph.D., Chairman; Clark Bowen, Ph.D.; John Dodd, Ph.D.; Warren D. Dolphin, Ph.D.; Jewett Dunham, Ph.D.; John G. Holt, Ph.D.; George Knaphus, Ph.D.; John Mutchmor, Ph.D.; Ruth B. Wildman, Ph.D.

Undergraduate and graduate courses and research opportunities in basic biology at Iowa State University are provided by the departments of Bacteriology, Biochemistry and Biophysics, Botany and Plant Pathology, Genetics, and Zoology and Entomology. The biology courses listed below are taught under a cooperative arrangement among these departments. In addition, the departments of Agronomy, Animal Science, Child Development, Food and Nutrition, Food Technology, Forestry, Horticulture, Psychology; departments within the College of Veterinary Medicine; and major programs in biomedical engineering, animal science, farm crops, and fisheries and wildlife biology provide undergraduate and graduate instruction as well as research programs in applied and specialized phases of the biological sciences.

Undergraduate Study

The 10-credit sequence Biol. 101, 102A, 102B, and 103 provides a broad look at the origin, structure, and function of living organisms as well as their interactions, particularly with respect to man. The general education sequence above is recommended to those students planning minimal work in the sciences. Students intending to take more advanced work in any of the biological sciences are encouraged to take the following 23-credit sequence: Biol. 101, 101A, 103, 106, 107, and 300. This sequence serves as a core around which a student majoring in biology or in one of the biological sciences will build his professional program.

For the undergraduate curriculum in sciences and humanities, major in biology, leading to the degree of Bachelor of Science, see Sciences and Humanities, Curriculum. The interdepartmental undergraduate major in biology offers broad training in the understanding of biological phenomena, concepts, and methods of investigation. The training provided in this program is particularly well suited for those planning to teach biology as a career. However, there are many opportunities in business, industry, and government for men and women well trained in biology. While some employment opportunities do exist in universities and governmental
laboratories for persons with a baccalaureate in biology, students who meet the necessary high standards are encouraged to continue their studies in a graduate college.

Undergraduates majoring in biology are advised by a faculty member from one of the participating departments. In addition to the 23 credits of core biology, their programs usually include the following basic courses: Bot. 306, 320, 404; Gen. 350; Zool. 320, 334, 455; B.&B. 301 or 401 or 404 and 405 and 406; C.Bio. 428. At least one additional course or sequence of courses in the biological sciences should be elected from the following list: Bact. 320, 509; Bot. 304, 500, 505, 506; Zool. 303, 306, 307, 311, 340, 370, 447, 464, 503, 504, 572; or a field biology sequence at Iowa Lakeside Laboratory. Other particularly desirable courses for students majoring in biology include: Bact. 330, 340; Bot. 424 or Zool. 402 or 405; Zool. 324; Gen. 305; B.&B. 461. Supporting courses usually include one year of physics, chemistry through 335, mathematics through 112 or 162, Stat. 101, and Com.S. 201. Biology majors seeking certification to teach secondary school biology must formally apply to the Teacher Education Committee, College of Sciences and Humanities, for admission to the Teacher Education Program. See Index, College of Education.

The courses listed above are neither fixed requirements nor do they include all those necessary for graduation. They are a guide to the student and his adviser in planning a curriculum best fitted to individual needs.

Graduate Study

In addition to the availability of graduate work in each of the departments of biological science at Iowa State, interdepartmental graduate programs in cell biology, immunobiology, and water resources are offered. See Cell Biology, Immunobiology, and Water Resources.

COURSES PRIMARILY FOR UNDERGRADUATE STUDENTS

101. PRINCIPLES OF BIOLOGY.
    (3-0) Cr. 3. F.W.S.S.
    Scope of biology as a science; organization and operation of living systems with emphasis upon cells, metabolism, growth, development, reproduction, inheritance, and basis for evolution.

101A. EXPERIMENTAL BIOLOGY.
    (1-3) Cr. 2. F.W.S.S.
    Prerequisite: Credit or classification in Biol. 101. Fundamental principles of biology in the laboratory. 101A is to be taken by students majoring in the biological sciences and all other students planning to take Biol. 106 or 107.

102A, 102B. BIOLOGY OF ORGANISMS.
    (0-4) Cr. 2 each. 102A: F.W.S.S.; 102B: F.W.S.S.
    Prerequisite: Credit or classification in 101. Structure vs. function, reproduction, and evolutionary position of representative organisms. 102A and 102B together constitute a general biology course in organismal biology for students who do not intend to take advanced work in the biological sciences. 102A and 102B may be taken concurrently with 101 and 103.

103. ENVIRONMENTAL BIOLOGY.
    (3-0) Cr. 3. F.W.S.S.
    Man's changing environment. Principles of ecology; population dynamics; biogeochemical cycles; misuse of resources; environmental pollution.

106. GENERAL ZOOLOGY.
    (Zool. 106) See Zool.

107. GENERAL BOTANY.
    (Bot. 107) See Bot.

300. INTRODUCTORY BACTERIOLOGY.
    (Bact. 300) See Bacteriology.

428. CELL BIOLOGY.

490. SPECIAL PROBLEMS.
    (Bact. 490) See Bacteriology.
    (Bot. 490) See Botany.
    (Zool. 490) See Zoology.

BIOMEDICAL ENGINEERING

Neal R. Cholvin, D.V.M., Ph.D., Chairman


Assistant Professors: William H. Brockman, Ph.D.; Mary Helen Greer, Ph.D.; Curran S. Swift, Ph.D.; Jack L. Wood, Ph.D.

Instructor: Robert W. Carithers, D.V.M., M.S.
The biomedical engineering program is interdisciplinary in scope and is sponsored jointly by the colleges of Engineering and Veterinary Medicine. Graduates with training in biomedical engineering are concerned with the application of engineering concepts and analytical techniques to biological and medical problems. They are interested in developing new concepts and instrumentation for measurements of living systems. In addition, they seek to understand those unique phenomena of living systems which have functional capabilities desirable for incorporation in the design of physical systems. Following completion of biomedical engineering training, they engage in research careers in the various fields of biomedicine and engineering, and in the environmental sciences. They may work on multidisciplinary teams in industrial, government, or academic research institutes. Individuals with this training can correlate and adapt engineering principles to the problem of medicine and biology. They are knowledgeable in, and can contribute to, such fields as physiology, anatomy, pharmacodynamics, and diagnostics by developing new quantitative methods of scientific investigation.

Undergraduate Study

A curriculum leading to a bachelor's degree in biomedical engineering is not offered. Undergraduate students planning graduate study are encouraged to develop knowledge in subjects prerequisite to biomedical engineering courses. For example, undergraduate students majoring in engineering, physics, or mathematics are encouraged to elect courses in organic chemistry, biochemistry, and biology. Undergraduate students majoring in life science areas should prepare for graduate study by electing courses in mathematics, engineering, and physics.

Graduate Study

Work is offered for the degrees Master of Science and Doctor of Philosophy with major in biomedical engineering, and minor work for students taking major work in other areas. Prerequisite to major and minor work in biomedical engineering is an undergraduate degree in one of the fields of engineering, life sciences, physical sciences, or a professional degree in one of the fields of medicine. Depending upon the individual's background, the major student will usually elect minor work in at least one of the following curricula: veterinary anatomy, biochemistry and biophysics, chemical engineering, computer science, electrical engineering, engineering mechanics, mathematics, mechanical engineering, veterinary anatomy, veterinary clinical sciences, veterinary physiology, psychology, or zoology. All students are encouraged to obtain previous background knowledge of organic chemistry, calculus, beginning differential equations, and physics. Candidates for the degree Doctor of Philosophy, will be required to demonstrate proficiency in one modern foreign language. For the degree Master of Science there is no language requirement.

The program of formal courses taken by students will be oriented toward developing proficiency in research in the interdisciplinary field. Selected background as well as advanced course work from other related disciplines will be taken in conjunction with appropriate biomedical engineering course topics. The program of formal courses will vary, depending upon the background and interests of the student, and will be determined in consultation with the student's committee.

In addition to the courses described later, the following courses are recognized to have strong bearing on studies in biomedical engineering:

B&B 561, 562, 661
Ch.E. 520, 554, 555, 556, 631, 632, 633
C.E. 418, 510, 516
Com.S. 447, 451, 452, 453, 484
E.E. 441, 445, 507, 508, 509, 565, 584, 677, 678
E.M. 420, 504, 505, 506, 514, 517, 544, 548, 571, 630
Nuc. E. 684
Math. 521, 522, 523
V.An. 510, 511
V.Phys. 510, 512, 513, 661
Zool. 650
COURSES PRIMARILY FOR UNDERGRADUATE STUDENTS

401. SCOPE OF BIOMEDICAL ENGINEERING.
(1-0) Cr. 1. W.
Prerequisite: Permission of program chairman.
Topics characteristic of research in biomedical engineering. For undergraduate students who wish to become familiar with the field of biomedical engineering.

471. BASIC BIOMEDICAL ELECTRONICS.
(3-0) Cr. 3. S.
Prerequisite: Phys. 113.
Practical introductory electronics including AC circuit theory, rectification, amplification, oscillators, and power supplies. Biological and medical instruments including pressure and flow transducers, signal processors, recorders, measurement of bioelectric potentials, and artifact suppression. (This course is designed for students majoring in the life sciences and is not acceptable for major or minor credit in biomedical engineering.)

COURSES PRIMARILY FOR GRADUATE STUDENTS, major or minor

521. ELECTRICAL CIRCUITS FOR BIOMEDICAL ENGINEERING.
(2-0) Cr. 2. W.
Prerequisite: E.E. 441, credit or classification in E.E. 445.
Introduction to concepts of frequency response, bridge circuits, and transformers.

522. ELECTRICAL CIRCUITS AND SYSTEMS FOR BIOMEDICAL ENGINEERING.
(3-3) Cr. 4. S.
Prerequisite: 521, E.E. 445.
Analysis and synthesis of electronic instrumentation and systems for biomedical engineering. Differential and DC amplifiers, electrical noise and filters, feedback, and stability.

536. BIOMEDICAL APPLICATIONS OF HEAT AND MASS TRANSFER.
(3-0) Cr. 3. W.
Prerequisite: 561, E.M. 420.
The principles of heat and mass transfer applied to biomedical problems. Applications in the study of physiology and in the design and operation of artificial organs.

561, 562, 563. COMPARATIVE MAMMALIAN ANATOMY AND PHYSIOLOGY.
(V.An. 561, 562, 563) (V.Phys. 561, 562, 563)
561: (3-3) Cr. 4. F; 562: (4-3) Cr. 5. W; 563: (3-3) Cr. 4. S.
Prerequisite: 561: Credit or classification in B.&B. 304; 562: 561, credit or classification in B.&B. 305; 563: 562.
Integrated teaching approach for graduate students who have had little or no previous training in anatomy and physiology. Designed for students in animal nutrition, biochemistry, engineering, food and nutrition, psychology, and other biological sciences. 561: Cellular structure and function, nervous system, sensory systems. 562: Cardiovascular system, respiration, acid-base balance, excretion. 563: Digestion, metabolism, reproduction, and endocrine systems.

571. THEORY AND TECHNIQUES OF BIOLOGICAL INSTRUMENTATION.
(3-0) Cr. 3. W.
Prerequisite: 563, Math. 321.
Characteristics of biological signals, transducers, error and artifact suppression, biological data acquisition and processing systems.

572. SIMULATION OF BIOLOGICAL SYSTEMS.
(3-3) Cr. 4. F.
Prerequisite: 522, 563, Math. 321.
Theory and application of analog computers. Development of mathematical models for biological control systems and application of analog computers to the simulation of these systems.

590. SPECIAL TOPICS.
Cr. 1 to 5 as arranged.
Prerequisite: Permission of instructor.
Investigation of problems of special interest in biomedical engineering.

593. ADVANCED BIOLOGICAL SYSTEM SIMULATION.
(3-0) Cr. 3. W.
Prerequisite: 572.
Selected simulation topics of current interest in biomedical engineering.

600. SEMINAR.
(1-0) Cr. 1. As arr.

661. BIOMEDICAL DATA PROCESSING.
(3-0) Cr. 3. Alt. S, offered 1973.
Prerequisite: 522.
Digital data acquisition systems used in biomedical research, hardware, data reduction algorithms, digital filters.

665. INFORMATION PROCESSING IN LIVING SYSTEMS.
(3-0) Cr. 3. Alt. S, offered 1972.
Prerequisite: 522.
Nervous and neuron network models, information processing in living systems, artificial intelligence and pattern recognition.

699. RESEARCH.
BOTANY AND PLANT PATHOLOGY

Frederick G. Smith, Ph.D., Head of Department


Associate Professors: Abraham H. Epstein, Ph.D.; Dean C. Foley, Ph.D.; Robert G. Franke, Ph.D.; Harry T. Horner, Jr., Ph.D.; George Knaphus, Ph.D.; Clifford E. LaMotte, Ph.D.; Roger Q. Landers, Ph.D.; Charlie A. Martinson, Ph.D.; Donald J. Nevins, Ph.D.

Assistant Professors: Joseph S. Burris, Ph.D.; Raymond L. Clark, Ph.D.; Robert F. Nyvall, Ph.D.; Cecil R. Stewart, Ph.D.; Ruth B. Wildman, Ph.D.; Jean W. Wooten, Ph.D.

Instructor: Donald R. Farrar, M.S.

Undergraduate Study

For undergraduate curriculum in sciences and humanities, major in botany, leading to the degree Bachelor of Science, see Sciences and Humanities, Curriculum.

For undergraduate major in plant pathology leading to the degree Bachelor of Science, see Agriculture, Curricula.

The department offers broad training in many basic and applied aspects of plant biology. The undergraduate programs are adapted to students of varied interests and prepare them for a wide range of opportunities in science-related occupations, including biology teaching, conservation and outdoor recreation activities, and traineeships in research, development, and sales programs of industry and agriculture.

The Iowa State University Seed Laboratory offers formal course work in seed science and technology and provides practical experience through part-time employment.

Undergraduate programs in the department usually include the following biological science courses: Biol. 101, 101A, 103, 106, 300; Bot. 107, 203, 306, 320, 404, 407, 424, 505. These are supplemented with others from the following: Bot. 216, 301, 304, 338, 399, 438, 500, 506, 564. Undergraduate minor programs and supporting courses usually include: B.&B. 301; Chem. 141, 141L, 142, 142L, 211, 334, 335; Gen. 301 or 350; Geol. 100; Math. 109, 110; Phys. 111, 112, 113; Zool. 320, 370, 455. Other science fields in which courses are commonly elected include agronomy, forestry, and horticulture. Courses at the Iowa Lakeside Laboratory at Lake Okoboji are recommended. The courses listed above are neither fixed requirements nor do they include all those necessary for graduation. They are a guide to the student and his adviser in planning a curriculum best fitted to individual needs.

Graduate Study

The department offers work for the degrees Master of Science and Doctor of Philosophy with majors in botany and plant pathology, and minor work for students majoring in other departments. Within the botany major the student may specialize in aquatic plant biology, cytology, ecology, economic botany, morphology, mycology, physiology, and taxonomy. A Master of Science nanthesis option is available.

Major and minor work in the area of cell biology is offered under a cooperative arrangement with the departments of Bacteriology, Biochemistry and Biophysics, Botany and Plant Pathology, Genetics, and Zoology and Entomology. See Cell Biology. The department is also a cooperating department in the water resources program. See Water Resources.

Students entering graduate programs in the department should have a broad liberal science background which includes basic coursework in the physical sciences and mathematics, as well as the biological sciences.

There is no foreign language requirement for the degree Master of Science. For the degree Doctor of Philosophy, the minimum requirement is one language, ordinarily German, French,
COURSES PRIMARILY FOR UNDERGRADUATE STUDENTS

107. GENERAL BOTANY. (Biol. 107) (3-6) Cr. 5. W.S.SSI.
Prerequisite: Biol. 101A. Dodd.
The relationship of structure and function, development, reproduction, and evolutionary relationships of representative plants.

110. TECHNICAL LECTURE.
(1-0) Cr. 1; 2.
Prepared for students in the plant pathology curriculum. Requirements and opportunities for work in the field of plant pathology.

155. LOCAL FLORA. (0-6) Cr. 3. S.SSI.
Field and laboratory studies of common local plants, including trees, shrubs, and spring flowering plants. Field trips. Not recommended for students with professional interests in plant science. Credits toward graduation not allowed if credits for 203 or 306 are recorded.

203. FIELD BOTANY. (0-6) Cr. 3. S.
Prerequisite: 107.
Field and laboratory study of plants in various local habitats. Introduction to use of keys and basic ecological concepts. Field trips.

216. WEED IDENTIFICATION AND CONTROL. (2-6) Cr. 4. F.
Prerequisite: 107 or Biol. 102A. Isely.

256. DENDROLOGY. (For. 256) (2-6) Cr. 4. F.
Prerequisite: 107.
Families, genera, and species of North American trees; angiosperms and gymnosperms. Field trips.

301. FIELD BIOLOGY. Cr. 4. SSI. (Lakeside Lab.)
Prerequisite: Written permission of instructor.
A study of plants in natural environments; includes methods of identification, collection, and preservation as well as basic ecological concepts. Field trips. Must be taken concurrently with Zool. 302.

304. PLANTS AND MAN. (3-2) Cr. 4. W.
Prerequisite: 107 or Biol. 102A. Isely.
Plants in relationship to the origin and diffusion of human cultures, evolution of cultivated plants, role of plants and plant sciences in the maintenance of present civilizations. Plants and plant products used for food and in industry, technology, and medicine.

306. PLANT TAXONOMY. (2-6) Cr. 4. S.SSI.
Prerequisite: 107; Pohl.
Principles of classification of seed plants; survey of major plant families, identification and field study of local plants. Field trips.

310. PLANT PHYSIOLOGY. (3-5) Cr. 4. W. SSI.
Prerequisite: 107 or Biol. 102A; Chem. 142, 142L.
Principles of vascular plant function including absorption and translocation of water and solutes, transpiration, photosynthesis, respiration, growth and development, and hormonal regulation.

320. PLANT PHYSIOLOGY. (3-5) Cr. 5. S.
Prerequisite: 107; Chem. 334 or B.A.B. 301.
Application of elementary physical and biological principles to the understanding of plant processes involved in assimilation, metabolism, and regulation of growth and development. Experimental approach emphasized. Credit toward graduation is not allowed for both 310 and 320.

Production, harvesting, processing, quality evaluation, storage, and marketing of seeds.

398. UNDERGRADUATE SEMINAR. (1-0) Cr. 1 each time taken. W.
Prerequisite: Junior classification and 12 credits in botany. Knaphus.
Meetings of students and staff to discuss topics of current interest in plant science.

404. PLANT ANATOMY. (2-6) Cr. 4. W.SSI.
Prerequisite: 107; Lerseth.
Structure and development of vegetative and reproductive organs of vascular plants, with emphasis on angiosperms. Includes introduction to basic microtechnique.

*407. PRINCIPLES OF PLANT PATHOLOGY. (2-4) Cr. 4. W.B.
Prerequisite: 310 or 320.
Principles underlying the nature and control of plant diseases.

*409. CROP PROTECTION. (Agron. 409) See Agronomy.

410. FUNDAMENTALS OF BOTANY. (3-5) Cr. 5. S.
Prerequisite: Fifteen credits in physical science. Knaphus, LaMotte. Study of plant forms and functions with approximately equal emphasis on morphological-evolutionary and on physico-chemical aspects of botany.

*416. FOREST PATHOLOGY. (For. 416) (2-4) Cr. 4. S.
Prerequisite: 310 or 320. McNabb.
Study of diseases of forest and shade tree diseases. Weekend field trips in northern and eastern Iowa. For satisfactory-fail credit only.

Decay and stains of wood, including forest product pathology. Field trips to local woods and lumber yards. For satisfactory-fail credit only.

or Russian. The requirement may be met by a passing score on the Education Testing Service examination, by presenting a minimum of six quarters or four semesters of B credits of college level work in an approved language, or by passing a departmental translation examination.

Students majoring in botany usually select minors from agronomy, bacteriology, biochemistry and biophysics, chemistry, forestry, genetics, geology, horticulture, physics, or zoology and entomology.

Open to graduate students for minor only: 320, 404, 407, 410, 416, 417, 424, 428, 438.
424. GENERAL PLANT ECOLOGY.
(2-3) Cr. 3. F.B.S.S.
Prerequisite: 203 or 306; Biol. 103 or Agron. 315 or For. 301. Landers.
Vegetation structure and function in relation to environment; classification; community dynamics; management of vegetation demonstrated by local field trips; ecosystem viewpoints. May be taken at Iowa Lakeside Laboratory with written permission of instructor.

428. CELL BIOLOGY.

429. SEED BIOLOGY.
(Agron. 429) (2-3) Cr. 3. W.
Prerequisite: 310 or 326. Burris.
Physiological aspects of seed development, maturation, longevity, and germination; ecological and agricultural implications of seed biology.

COURSES PRIMARILY FOR GRADUATE QUALIFIED UNDERGRADUATES

500. FRESHWATER ALGAE.
(3-3) Cr. 4. F. (SB1. Lakeside Lab.)
Prerequisite: Fifteen credits in biological science. Dodd.
Role of algae in freshwater habitats; environmental factors affecting growth and distribution; basic procedures for collecting, identifying, and enumerating. Field trips. May be taken at Iowa Lakeside Laboratory with written permission of instructor.

505. MORPHOLOGY OF GREEN PLANTS.
(3-6) Cr. 5. S.
Prerequisite: Fifteen credits in biological science including 107. Farrar.
Significant evolutionary trends in algae, bryophytes, and vascular plants and their relation to modern concepts of phylogeny.

506. PRINCIPLES OF MYCOLOGY.
(2-6) Cr. 4. F.
Prerequisite: Fifteen credits in biological science. Tiffin.
Mycology, morphology, cytology, and physiology of fungi; their relation to agriculture and industry.

509. GENERAL VIROLOGY.
(Bact. 509) See Bacteriology.

511. PLANT NUTRITION.
(3-0) Cr. 3. F.
Prerequisite: 320, Phys. 112, Chem. 335. LaMotte, Nevins, Stewart.
Mineral nutrition, water relations, and translocation in vascular plants.

512. PLANT GROWTH REGULATION.
(3-0) Cr. 3. W.
Prerequisite: 320, Chem. 335. LaMotte.
Vascular plant growth, correlative phenomena in development, and hormones involved in their regulation.

513. PLANT METABOLISM.
(3-0) Cr. 3. S.
Prerequisite: 320, Phys. 112, Chem. 335. Nevins, Stewart.
Photosynthesis, respiration and other aspects of metabolism in plants.

514. PLANT MORPHOGENESIS.
(3-0) Cr. 3. S.
Prerequisite: 404, 512. Horner, LaMotte.
Causal mechanisms underlying patterns of development.

517. PHYSIOLOGICAL METHODS AND TECHNIQUES.
(0-6 or 9) Cr. 2 or 3. F.
Prerequisite: Credit or classification in 511 or 512 or 513. Nevins.

490. SPECIAL PROBLEMS.
(Biol. 490) Cr. 2 to 5 each time taken.
Prerequisite: Ten credits in botany and permission of instructor.
A. Morphology.
B. Physiology.
C. Plant Pathology.
D. Mycology.
E. Taxonomy.
F. Plant Ecology.
G. Economic Botany.
H. Honors Program.
J. Cytology.
K. Aquatic Plant Biology

550. SPECIAL TOPICS.
Cr. 2 to 5 each time taken.
Prerequisite: Fifteen credits in botany, permission of instructor.
A. Morphology.
B. Physiology.
C. Plant Pathology.

STUDENTS, major or minor, open to qualified undergraduates

Research methods and techniques in plant physiology. Permission of instructor required for 2-credit option.

527, 528. ADVANCED CELL BIOLOGY.

541. DISEASES OF ECONOMIC PLANTS.
(3-3) Cr. 4. F.
Prerequisite: 407.
Plant diseases caused by bacteria, fungi, nematodes, and viruses. For students not majoring in plant pathology.

548. PALEOBOTANY.
Prerequisite: Permission of instructor. Farrar. Introduction to the morphology, relationships, and identification of fossil plants. Field trips.

564. AQUATIC PLANTS.
(2-8) Cr. 4. F.
Prerequisite: 306. Wooten.
Taxonomy, ecology, and morphological specializations of aquatic plants, with emphasis on vascular plants. Field trips.

574. PLANT NEMATOLOGY.
(3-3) Cr. 4. F.
Prerequisite: 401 or 416 or 417. Norton. Morphology, anatomy, and life cycles of commonly encountered plant-parasitic nematodes; symptom expression; control; concepts.

575. FIELD MYCOLOGY.
(2-6) Cr. 4 each time taken. SS1. 1973. (SSII. 1972. Lakeside Lab.)
Prerequisite: Nine credits in botany. Tiffin. Collection and taxonomy of fungi and relation of their occurrence to environmental factors. Preparation and utilization of mycological exsiccati. Field trips. May be taken at Iowa Lakeside Laboratory with written permission of instructor.

584. ADVANCED PLANT ECOLOGY.
(2-3) Cr. 3. F.
Prerequisite: 424. Landers.
Theories and approaches to the study of vegetation from Clements to the most recent authors; plant succession and community stability. Field trips.

590. SPECIAL TOPICS.
Cr. 2 to 5 each time taken.
Prerequisite: Fifteen credits in botany, permission of instructor.
A. Morphology.
B. Physiology.
C. Plant Pathology.

Administrated by the College of Agriculture. Courses not marked by an asterisk are administered by the College of Sciences and Humanities.
**591. ADVANCED GENERAL PLANT PATHOLOGY.**
(4-3) Cr. 5. F.
Prerequisite: 404, 407, 506, 509, 574; 511 or 612 or 513, Bact. 300, Gen. 301 or 350, and credit or classification in Stat. 401.
Representative plant diseases, plant disease concepts and processes, and literature review.

**592. HOST-PARASITE INTERACTIONS.**
(4-3) Cr. 5. Alt. W, offered 1972.
Prerequisite: 591.
Study of interactions between and among host populations, parasite populations, and the environment.

**593. EPIPHYTOLOGY.**
Prerequisite: 591, Stat. 402.
Study of interactions between and among host populations, parasite populations, and the environment.

**COURSES FOR GRADUATE STUDENTS, major or minor**

**601. ADVANCED MORPHOLOGY.**
(2-0) Cr. 2 each time taken. F.W.S.
Prerequisite: 505.
Special topics in major plant groups. Reading, discussions, oral and written term papers.

**605. CYTOGENETICS.**
(3-0) Cr. 3. Alt. W, offered 1972.
Prerequisite: 505, Smith.
Special physiological and morphological aspects of plant disease.

**624. PHYSIOLOGY OF FUNGI.**
(3-0) Cr. 3. Alt. W, offered 1972.
Prerequisite: 505, Smith.
Special physiology of fungi; nutrition, metabolism, growth, and toxicity.

**629. FINE STRUCTURE OF PLANT CELLS.**
(3-0) Cr. 3. S.
Prerequisite: 404; C.Bio. 428 or 528. Horner and Wildman.
Study of structure and function of cells and cellular components at various levels of evolutionary development.

**641, 642, 643. GENERAL MYCOLOGY.**
(2-6) Cr. 4 each yr.
Prerequisite: 407 or 416 or 417. Tiffany.
Taxonomy, morphology, and phylogeny of slime molds and fungi (phycycomycetes, ascomycetes, fungi imperfecti, and basidiomycetes).

**646. ANIMAL MYCOLOGY.**
(3-0) Cr. 3. Alt. W, offered 1972.
Prerequisite: 506. Tiffany.
Morphology, cytology, and physiology of fungi causing animal mycoses; includes superficial mycoses, dermomyces, and systemic mycoses.

**679, 680. MICROSCOPY I AND II.**
(2-9) Cr. 5 each yr. 679F; 680W.
Prerequisite: 679: 310 or 320, 404, permission of instructor; 680: 679. Horner.
Current theories and methods encompassing light and electron microscopy. Chemical and physical preparations of specimens, qualitative and quantitative cytochemistry and histochemistry, autoradiography, microphotography, and ancillary techniques.

**690. ADVANCED PLANT TAXONOMY.**
(2-3) Cr. 3. S.
Prerequisite: 306; Gen. 301 or 360. Isely.
Literature and philosophy of plant classification, processes of speculation in higher plants, sources and interpretation of data, research methods, and plant nomenclature.

**594. PHYTOGEOGRAPHY.**
(9-6 and two weekend field trips.) Cr. 3. F.
Prerequisite: Fifteen credits of biological science, including Bot. 306; historical geology recommended. Pohl.
History and nature of the principal vegetational formations, particularly of North America. Origins of vascular flora; the Arcto-tertiary flora; Tertiary flora of the eastern and western U.S.; origins of grassland and desert floras; Pleistocene and recent floristic history of the North American vegetation.

**595. AGROSTOLOGY.**
(2-4) Cr. 4. W.
Prerequisite: 306. Pohl.
Morphology, classification, and identification of grasses; utilization of grasses in agriculture and grazing.

*Administered by the College of Agriculture. Courses not marked by an asterisk are administered by the College of Sciences and Humanities.*
**COURSES OFFERED AT THE IOWA LAKESIDE LABORATORY**

**COURSES OFFERED AT THE IOWA LAKESIDE LABORATORY**

301L. (L:101) FIELD BIOLOGY.
(4-12) Cr. 4. SSI.
A study of plants in natural environments; includes methods of identification, collection, and preservation as well as basic ecological concepts. Field trips. Must be taken concurrently with Zool. 302L.

424L. (L:120) GENERAL PLANT ECOLOGY.
(8-24) Cr. 8. SSI.
Prerequisite: 203 or 306; Biol. 103 or Agron. 315 or Fore. 301.
Vegetation structure and function in relation to environment; classification; community dynamics; management of vegetation demonstrated by local field trips; ecosystem viewpoints.

490. SPECIAL PROBLEMS.
(See preceding section).

500L. (L:109) ALGOLOGY.
(8-24) Cr. 8. SSI.
Prerequisite: Nine credits in botanical science. Identification and morphological study of algae with special reference to the fresh-water algae of the midwest. Field trips.

575L. (L:105) FIELD MYCOLOGY.
(8-24) Cr. 8. SSI, offered 1972.
Prerequisite: Nine credits in botany.
Collection and taxonomy of fungi and relation of their occurrence to environmental factors. Preparation and utilization of mycological exsiccati. Field trips.

579X L. (L:117) ECOLOGY AND SYSTEMATICS OF DIATOMS.
(8-24) Cr. 8. SSI.
Prerequisite: Fifteen credits in biological science. Field experience in the study of fresh-water diatoms. Environmental factors affecting growth and distribution are stressed. Techniques, collection, and preparation of diatom samples.

579Y L. (L:105) FIELD BIOLOGY OF ANGIOSPERMS.
(8-24) Cr. 8. SSI.
Prerequisite: Fifteen credits in biological science. Field and laboratory study of local flowering plant populations, synthesizing the evolutionary, systematic, and ecological approaches. Methods of collecting, sampling, analyzing, and recording information; individual and group projects. For students with background in genetics and taxonomy.

699. RESEARCH.
(See preceding section.)

**CELL BIOLOGY**

Advisory Committee: C.C. Bowen, Ph.D., Chairman; Alan G. Atherly, Ph.D.; Darrel E. Goll, Ph.D.; Darryll E. Outka, Ph.D.; Peter A. Pattee, Ph.D.; James R. Redmond, Ph.D.

Undergraduate Study

A special program in cell biology is not offered for the baccalaureate. Undergraduates wishing to prepare for graduate study in cell biology should elect laboratory courses in bacteriology, botany, and zoology; an introductory course in genetics; mathematics through calculus; chemistry through organic; and one year of physics. C.Bio. 428 or 527, 528 are recommended to qualified undergraduates desiring an introduction to this area.

Graduate Study

Work is offered for the degrees Master of Science and Doctor of Philosophy with major in cell biology under an interdepartmental cooperative arrangement; minor work is offered to students taking major work in other areas. Facilities exist in the several departments for fundamental research in such areas as electron microscopy of cells, their chemistry and physiology particularly in relation to molecular architecture, cellular mechanisms in heredity and radiation response, and the special cytology of bacteria, algae, fungi, protozoa and higher organisms.

A student majoring in cell biology will choose a major professor from the graduate faculty membership of the cooperating departments and will develop his program of study under the guidance of a committee nominated by the coordinating committee and appointed by the Dean of the Graduate College.

For the Master of Science degree, competency in one foreign language is required, as dem-
demonstrated by an ETS proficiency rating of at least the 25th percentile or at least comparable proficiency as demonstrated to the satisfaction of the student’s committee. The language requirement for the Ph.D. degree may be met in either of the following ways: (1) One language with an ETS proficiency rating of the 25th percentile or above, or at least comparable proficiency in that language as demonstrated to the satisfaction of the student’s committee, plus either a second language at the same proficiency level or successful completion of a substantial additional requirement as directed by the student’s committee; or (2) One language with an ETS proficiency rating in the 50th percentile or above, or at least comparable proficiency in that language as demonstrated to the satisfaction of the student’s committee.

The following is a partial listing of courses that relate directly to cell biology: Bact. 645; B.&B. 574 and 575; Bot. 629, 679, and 680; Gen. 605; Zool. 529, 627, and 650.

Open to graduate students for minor graduate credit only: 428.

COURSES PRIMARILY FOR UNDERGRADUATE STUDENTS

428. CELL BIOLOGY.
(Biol. 428, Bot. 428, Zool. 428) (3-0 or 3-3)
Cr. 3 or 4. F.
Prerequisite: Fifteen credits in the biological sciences; organic chemistry. Permission of instructor required for enrollment in laboratory.
Viles.
Biological organization and function at the cellular level.

COURSES PRIMARILY FOR GRADUATE STUDENTS, major or minor, open to qualified undergraduates

527, 528. ADVANCED CELL BIOLOGY.
(B.&B. 527, 528; Bot. 527, 528; Zool. 527, 528)
(3-6) Cr. 5 each; 527: F; 528: W.
Prerequisite: 527: Permission of instructor; 528: 527. Bowen, Outka, Viles.
Structure and function of cytoplasm and nucleus; molecular architecture of intracellular differentiation.

590. SPECIAL TOPICS.
(2-0) Cr. 3 each time taken.
Prerequisite: Permission of instructor.
Current frontier areas in cell biology.

COURSES FOR GRADUATE STUDENTS, major or minor

698. SEMINAR IN CELL BIOLOGY.
(Bact. 698, B.&B. 698, Bot. 698E, Gen. 698, Zool. 698) (1-0) Cr. 1. S.
Prerequisite: Permission of instructor. Bowen.
Concepts and research in cell biology.

699. RESEARCH.

CERAMIC ENGINEERING

David R. Wilder, Ph.D., Head of Department

Professors: Charles M. Dodd, Cer.E.; Thomas D. McGee, Ph.D.
Associate Professors: John T. Jones, Ph.D.; Elmer A. Rossuer, Dr.Rer.Nat.
Assistant Professors: Michael F. Berard, Ph.D.; Orville Hunter, Ph.D.

Undergraduate Study

For undergraduate curriculum in ceramic engineering, leading to the degree Bachelor of Science, see College of Engineering, Curricula.

Ceramic engineering deals with those products formed from natural and synthetic minerals which are rendered durable by a process of heat treatment at high temperatures. These include most of the nonmetallic inorganic substances manufactured into electronic components, glass of all types, porcelain enamels, abrasives, cements, ultra-high temperature resistant refractories, many materials of construction, and other similar products.
308 Courses and Programs

The ceramic engineer is concerned with the technical problems encountered in the research, development, control, production, and use of these products and materials. He must also be well versed in the methods employed for forming, drying, and firing of ceramic raw materials. The ceramic engineer receives a well-rounded education to fit him for research, production, equipment and plant design, or sales engineering, depending upon the capabilities and inclination of the individual.

Graduate Study

The department offers work for the degrees Master of Science, Master of Engineering, and Doctor of Philosophy with major in ceramic engineering, and minor work to students taking major work in other departments.

Prerequisite to major graduate work is the completion of a curriculum in ceramic engineering, ceramic technology, engineering, or physical science equivalent to that required of undergraduate students at this institution.

There is no foreign language requirement for the degree Master of Science or Master of Engineering.

For the degree Doctor of Philosophy the foreign language requirement may be met in one of the following three ways: (1) A score of at least 400 in each of two Educational Testing Service foreign language examinations (French, German or Russian); (2) A score of at least 600 in one Educational Testing Service foreign language examination (French, German or Russian); (3) One year of formal course work (nine quarter hours) in either French, German, or Russian with a grade of at least C may be substituted for an Educational Testing Service score of 400; two years of formal course work (18 quarter hours) for an Educational Testing Service score of 600.

Open to graduate students for minor credit only: 341, 342, 343, 351, 362, 411, 412, 413.

COURSES PRIMARILY FOR UNDERGRADUATE STUDENTS

100. ORIENTATION. (1-0) Cr. R; S.
201, 202, 203. SEMINAR. (1-0) Cr. R; Yr.
221. CERAMIC MATERIALS. (4-0) Cr. 4. F.

Crystal structures of ceramic materials. Interaction of structure and defects with mechanical and thermal properties.

222. CERAMIC ENGINEERING OPERATIONS. (3-3) Cr. 4. W.
Prerequisite: 221.

Engineering theory and problem solution in materials handling and preparation.

223. CERAMIC MATERIALS PROCESSING. (3-3) Cr. 4. S.
Prerequisite: 222.

Batching, forming, and drying of ceramic raw materials.

233. HIGH-TEMPERATURE TECHNOLOGY. (3-3) Cr. 4. S.
Prerequisite: Chem. 142, 142L, Phys. 223.

Principles and calculations involved in producing, measuring, and controlling the high-temperature environment and ceramic processing.

300. INSPECTION TRIP. Cr. R; S.

Prerequisite: Junior ceramic engineering classification.

One-week trip inspecting ceramic plants and studying industrial methods of production.

301, 302, 303. SEMINAR. (1-0) Cr. R; Yr.
341. HIGH-TEMPERATURE PROCESSES. (3-3) Cr. 4. F.

Prerequisite: 333.

Use of high-temperature treatment to effect atomic transport and densification through sintering and vitrification. Prediction of final fired structure by means of phase equilibrium diagrams.

342. VITREOUS STATE. (3-3) Cr. 4. W.


343. ELECTRONIC CERAMICS. (3-0) Cr. 3. S.
Prerequisite: 221; credit or classification in E.E. 446 and Chem. 323.

Fundamentals of electronic processes in ceramic materials.

347. CERAMIC CONSTRUCTION MATERIALS. (3-0) Cr. 3. W.

Correlation of the processing variables and the physical properties of the ceramic materials used in construction. Processing of glass, structural clay products, and composite materials. Primarily for architecture students.

351. MICROSTRUCTURE OF CERAMIC MATERIALS. (1-6) Cr. 3. F.

Prerequisite: 233.

Characterization of ceramic materials from information obtained by microscopy and X-ray analysis.

353. PHYSICAL PROPERTY MEASUREMENTS. (1-6) Cr. 3. S.

Prerequisite: Credit or classification in 343.

Thermal, kinetic, mechanical, and electrical property determination in ceramic materials.

362. COLLOID CHEMISTRY OF CERAMIC MATERIALS. (3-0) Cr. 3. W.

Prerequisite: 221, Chem. 321.
Fundamental phenomena associated with surfaces and colloidal systems of ceramic and related materials.

401, 402, 403. SEMINAR. (1-0) Cr. R; Yr.

411. CERAMIC INDUSTRIES I. (3-0) Cr. 3. F.
Prerequisite: 342.
Relationship of composition, crystal structure, fabrication techniques, and thermal processing to the properties of whiteslures and technical ceramics.

412. CERAMIC INDUSTRIES II. (3-0) Cr. 3. W.
Prerequisite: 351.
Manufacture, properties, uses, performance, and testing of basic, neutral, and acid refractories.

413. CERAMIC INDUSTRIES III. (3-0) Cr. 3. S.
Prerequisite: 342.
Plant layout, processing, economic aspects, and structure of the enamel and glass industries. Inspection trip to porcelain enamel plant.

422. CERAMIC ENGINEERING DESIGN. (1-9) Cr. 4. W.
Prerequisite: 351.
Introduction to the design of laboratory furnaces, production dryers, and production kilns.

423. CERAMIC ENGINEERING DESIGN. (1-6) Cr. 3. S.
Prerequisite: 422.
Ceramic plant layout and design.

431, 432, 433. SENIOR PROJECT. (1-3) Cr. 3. F; 432: (1-6) Cr. 3. W; 433: (0-6) Cr. 2. S.
Prerequisite: 351, 353.
An individual ceramic development or research project designed by the student.

490. SPECIAL PROBLEMS. (0-3 to 15) Cr. 1 to 5.
Introduction to research methods, investigation, and continuation of research problems for the undergraduate student.
H. Honors.

COURSES PRIMARILY FOR GRADUATE STUDENTS, major or minor, open to qualified undergraduates

512. CERAMIC TECHNOLOGY. (3-0) Cr. 3. Offered as arr.
Prerequisite: Permission of instructor.

513. CERAMIC TECHNOLOGY. (3-0) Cr. 3. Offered as arr.
Prerequisite: 343 or permission of instructor.
Semiconducting, dielectric, and magnetic properties of ceramic materials and their interpretation with respect to composition and crystal structure.

514, 515. ELECTRON MICROSCOPY OF INORGANIC MATERIALS. 514: (2-6) Cr. 4; 515: (0-6) Cr. 3. Offered as arr.
Prerequisite: 514: Phys. 223; 515: 514.
Introduction to the theory of electron optics and image formation. Principles of electron microscope operation including various diffraction modes and X-ray microanalysis. Specimen preparation methods for inorganic materials.

516. DEFECTS IN CRYSTALLINE CERAMICS. (3-0) Cr. 3. Offered as arr.
Prerequisite: Major in ceramic engineering.
Thermodynamics of point defects in ceramic crystals. Control of point defect concentration by stoichiometry, doping, and atmosphere.

521. DIFFUSION IN CERAMIC SYSTEMS. (3-0) Cr. 3. Offered as arr.
Prerequisite: Permission of instructor.

522. THEORY AND PROPERTIES OF COLLOIDAL AND RELATED CERAMIC MATERIALS. (3-3) Cr. 4. Offered as arr.
Prerequisite: Permission of instructor.
Fundamentals of colloidal phenomena as applied to ceramic systems, including theory of defoculation, rheology, and measurements.

630. SPECIAL TOPICS. Cr. arr.
Prerequisite: Permission of instructor.

COURSES FOR GRADUATE STUDENTS, major or minor

611. MECHANICAL PROPERTIES OF CERAMIC MATERIALS. (3-0) Cr. 3. Offered as arr.
Prerequisite: 516.

612. KINETICS OF CERAMIC PROCESSES. (3-0) Cr. 3. W.
Fundamentals of solid reactions occurring at elevated temperatures. Sintering, vitrification, diffusional mechanisms and effects, reaction rate theory.

613. MEASUREMENTS IN HIGH TEMPERATURE SYSTEMS. (3-0) Cr. 3. S.
Theory, limitation, and problems of analysis of measurements at elevated temperatures. Furnaces and techniques for determination of mechanical, physical, structural, and chemical properties of ceramic materials at elevated temperatures.

618. CRYSTAL CHEMISTRY OF CERAMIC MATERIALS. (3-0) Cr. 3. Offered as arr.
Prerequisite: 342. Fundamentals of crystal chemistry and the systematic study of the structures of the ceramic materials.

619. PHASE EQUILIBRIA OF CERAMIC SYSTEMS. (3-0) Cr. 3. S.
Prerequisite: 518 or permission of instructor.
Phase equilibria of the ceramic and closely related systems.

699. RESEARCH.
CHEMICAL ENGINEERING

George Burnet, Jr., Ph.D., Head of Department


Associate Professors: Edgar V. Collins, M.S.; Kenneth R. Jolla, Ph.D.; Allen H. Pulsifer, Ph.D.; Richard C. Seagrave, Ph.D.; Robert W. Shearer, B.S.; John B. Sheeler, Ph.D.; Frank O. Shuck, Ph.D.; John D. Stevens, Ph.D.; F. Dee Stevenson, Ph.D.

Assistant Professors: Renato G. Bautista, Ph.D.; Anthony L. Frey, Ph.D.; Dean L. Ulrichson, Ph.D.

Instructor: Larry G. Bauer, M.S.

Undergraduate Study

For undergraduate curriculum in chemical engineering leading to the degree Bachelor of Science, see College of Engineering, Curricula.

The chemical engineer is concerned with the processes and equipment for bringing about changes in the state of matter and for transforming energy. He makes use of chemical and nuclear reactions and many physical operations such as mixing, distillation, crystallization, vaporization, and filtration. He is trained in the fundamentals of science and mathematics as well as in the principles of fluid flow, heat and mass transfer, and in thermodynamics. He is usually employed by chemical and allied industries, but he frequently makes contributions in the electronic, nuclear, metallurgical, and aerospace industries; in the fields of biomedical and biochemical engineering; and in private and public research and educational institutions. He is helping to solve important problems arising in the exploration of the ocean depths and of outer space, and is participating in the development of new devices for medical uses and new methods for processing information. He may be assigned specifically to design, construct, operate, and manage large manufacturing plants, or he may work on the development of new products and processes, or he may carry out basic research on the properties of matter or on systems used for processing matter and information.

A five-year cooperative work-study program is available in the Chemical Engineering Department. See Cooperative Programs, College of Engineering.

Graduate Study

The department offers work for the degrees Master of Science, Master of Engineering, and Doctor of Philosophy with major in chemical engineering, and minor work to students taking major work in other departments.

Prerequisite to major graduate work is the completion of an undergraduate curriculum substantially equivalent to that offered in chemical engineering at this institution.

There is no foreign language requirement for the degrees Master of Science or Master of Engineering. For the degree Doctor of Philosophy a student must demonstrate a satisfactory reading knowledge of either French, German, Russian, or Spanish. For students whose native language is not English, the ability to communicate in English, certified by the Department of English, will, upon recommendation of the student's advisory committee, be acceptable as a substitute for the reading knowledge of one foreign language.

Minor work usually will be selected from chemistry, mechanical engineering, mathematics, physics, statistics, or nuclear science.

Open to graduate students for minor credit only: 351, 352, 353, 435, 450, 451, 452, 454, 461, 462, 463, 471, 472, 473.
COURSES PRIMARILY FOR UNDERGRADUATE STUDENTS

100. TECHNICAL LECTURE.
(1-0) Cr. R; S.
A discussion of the chemical engineering profession.

161. 162, 163. CHEMICAL ENGINEERING LABORATORY.
(0-3 to 9) Cr. 1 to 3 each time elected. Yr.
An approved assignment as laboratory assistant on special problems.

201. INTRODUCTION TO CHEMICAL ENGINEERING.
(3-0) Cr. 3. F.
Prerequisite: Credit or classification in Chem. 142 and 142L.
The application of stoichiometric principles to industrial problems.

202. MATERIAL AND ENERGY BALANCES.
(3-0) Cr. 3. W.
Prerequisite: 201.
Application of material and energy balance calculations to chemical engineering processes.

210. CHEMICAL PROCESSING.
(3-0) Cr. 3. S.
Prerequisite: 201.
Introduction to chemical processes involving chemical conversion and separation with emphasis on economic analysis, process design, and optimization. Consideration of typical as well as new processes to provide an over-all view of the chemical engineering function.

300. JUNIOR INSPECTION TRIP.
Cr. R; S.
Prerequisite: Junior classification in Chem. E. Visits to chemical industries and plants in an industrial area for one week.

310. ENGINEERING UNIT OPERATIONS.
(3-2) Cr. 4. F.S.
Prerequisite: Chem. 142, 142L, Math. 213, Phys. 222.
Material and energy balances, fluid flow, heat and mass transfer, rate processes, stage operations, and system analogues.

315. STOICHIOMETRY.
(4-0) Cr. 4. F.
Prerequisite: Math. 213, Phys. 222.
Material and energy balances. Introduction to rate processes.

341. COMPUTER APPLICATIONS IN CHEMICAL ENGINEERING.
(2-3) Cr. 3. S.
Prerequisite: 351, 352, Math. 213.
Applications of digital and analog computers to the solution of problems arising in transport processes, chemical reactions, process dynamics, and equipment design.

351. MULTISTAGE OPERATIONS.
(4-0) Cr. 4. F.
Prerequisite: 202.
Application of principles in 201 and 202 and physical chemistry to multistage processes for separation of chemical components. Equilibrium stages, analysis of distillation, extraction, evaporation and crystallization. Problems involving design and operation of multistage process equipment are considered.

352. MOMENTUM TRANSPORT OPERATIONS.
(5-0) Cr. 5. W.
Prerequisite: 202, Math. 213, Phys. 221.
Concepts of momentum and mechanical energy transport in fluids are studied by examining problems related to fluid friction, viscosity, piping systems, settling, and flow through porous media. The subjects of filtration, sedimentation, and non-Newtonian fluids are also given attention.

353. ENERGY TRANSPORT OPERATIONS.
(3-0) Cr. 3. S.
Prerequisite: 352 or E.M. 378.
Consideration of thermal energy transfer problems which occur in the process industry. Principles developed in 352 are extended to conduction and convection of heat. Design of heat transfer equipment is a major topic. Radiant heat transfer is also covered.

401. 402, 403. TECHNICAL SEMINAR.
(1-0) Cr. R; Yr.
Discussion of current problems of importance to chemical engineers.

435. PROCESS CONTROL.
(3-0) Cr. 3. F.
Prerequisite: 341, 353, Math. 321.
Mechanisms used to control industrial processes: their applications and limitations. Dynamics of chemical process components and process control systems. Analog simulation of process systems.

450. PROCESS CONTROL LABORATORY.
(0-4) Cr. 2. F.
Prerequisite: Credit or classification in 435.
Experiments in chemical process dynamic and control. Measurement of system parameters, transient response, and frequency response. Simulation of control systems. Transient response of chemical process equipment.

451, 452. CHEMICAL ENGINEERING LABORATORY.
(0-6) Cr. 2 each. W,S.
Prerequisite: Credit or classification in 454.
Measurement of transport properties and rates of heat, mass, and momentum transfer; investigation of process equipment, unit operations, and chemical reaction systems. Treatment of data, reports, and equipment design.

454. MASS TRANSPORT OPERATIONS.
(3-0) Cr. 3. S.
Prerequisite: 353.
The subjects of diffusion and mass transfer are studied in the context of chemical processes involving separation and synthesis. This course is an extension of 352 and 353. Problems of gaseous and liquid absorption, simultaneous heat and mass transfer, and chemical reactor technology are discussed.

461, 462. CHEMICAL ENGINEERING THERMODYNAMICS.
461: (3-0) Cr. 3. F; 462: (2-0) Cr. 2. W.
Prerequisites: 461: Math. 112, Phys. 222; 462: 461, and 341 or Com.S. 201.
Application of thermodynamic principles to chemical engineering problems. Thermodynamic properties of fluids, phase equilibria, chemical-reaction equilibria.

463. CHEMICAL REACTOR DESIGN.
(3-0) Cr. 3. S.
Prerequisite: 462.
Kinetics of chemical reactions, design of homogeneous and heterogeneous flow and batch reactors.

471, 472, 473. CHEMICAL ENGINEERING DESIGN.
(1-6) Cr. 3 each. Yr.
Prerequisite: 471: Credit or classification in 454, 461; 472: credit or classification in 462; 473: 472, credit or classification in 463.
Principles of process and plant design; economic and feasibility analysis; application of optimization techniques.

490. SPECIAL PROBLEMS.
(0-3 to 18) Cr. 1 to 6.
Introduction to research methods; investigation of an approved topic.
H. Honors.
COURSES PRIMARILY FOR GRADUATE QUALIFIED UNDERGRADUATES

500. INDIVIDUAL PROBLEMS.
Prerequisite: Major in chemical engineering. Investigation of an approved topic on an individual basis.

515. ORGANIC CHEMICAL INDUSTRIES.
(3-0) Cr. 3. SS.
Prerequisite: Chem. 335. Chemical engineering aspects of manufacture of the principal organic chemicals.

516. HEAVY INORGANIC CHEMICAL AND FERTILIZER INDUSTRIES.
(3-0) Cr. 3. SS.
Prerequisite: Permission of instructor. Manufacture of commercial fertilizers and related heavy inorganic chemicals.

517. CHEMURGIC INDUSTRIES.
(3-0) Cr. 3. SS.
Prerequisite: Chem. 335. Occurrence, composition, and properties of agricultural products and their industrial treatment and utilization.
A. Carbohydrates and carbohydrate-bearing materials.
B. Vegetable and animal oils and fats.
C. Other products of agricultural origin.

520. BIOCHEMICAL ENGINEERING.
(3-0) Cr. 3. W.
Application of basic chemical engineering principles in biochemical and biological process industries such as fermentation, food processing, enzyme technology, and biological waste treatment.

535. PROCESS DYNAMICS.
(3-0) Cr. 3. SS.
Prerequisite: 435. Applications of dynamic analysis techniques in the study of nonsteady state chemical processes.

541, 542. CALCULATION METHODS FOR CHEMICAL ENGINEERS.
(3-0) Cr. 3 each. P.W.
Prerequisite: 541: 454, credit or classification in Chem. 322; 542: 541. Advanced analysis and design of equipment and processes by digital computer simulation and solution.

545. INDUSTRIAL CHEMICAL PROCESS MODELS.
(3-0) Cr. 3. SS.
Prerequisite: 542. Construction and application of linear and nonlinear deterministic models for optimizing, planning, and scheduling chemical manufacturing processes. Introductory applications of stochastic models to chemical processes.

COURSES FOR GRADUATE STUDENTS, MAJOR OR MINOR

554, 555, 556. ADVANCED UNIT OPERATIONS.
(3-0) Cr. 3 each. Yr.
Prerequisite: 454. Momentum transport processes in fluid-solid systems. Derivation and analysis of the basic equations of change; laminar and turbulent flow; flow through porous media and fluidizations; flow past submerged bodies.

565. MULTI-STAGE OPERATIONS.
(3-0) Cr. 3. SS.
Prerequisite: 551. General theory of multi-stage processes such as distillation, absorption, extraction, and ion exchange. Applications of finite difference calculus in cascade theory. Use of equilibrium phase relations and design optimization techniques.

566. SOLVENT EXTRACTION.
(3-0) Cr. 3. SS.
Prerequisite: 551. Theory and application of solvent extraction to industrial processing.

581. THERMODYNAMICS OF SINGLE COMPONENT SYSTEMS.
(3-0) Cr. 3. F.
Prerequisite: 461. Application of thermodynamic laws and fundamental relations to single component systems. Properties of nonideal fluids.

582. THERMODYNAMICS OF MULTI-COMPONENT SYSTEMS.
(3-0) Cr. 3. W.
Prerequisite: 581. Thermodynamic properties of solutions. Phase equilibria and chemical reaction equilibria.

586. CHEMICAL ENGINEERING KINETICS.
(3-0) Cr. 3. S.
Prerequisite: 463. Theory of absolute reaction rates; mass and heat transfer in catalytic beds; treatment of differential and integral conversion data.

587. SPECIAL TOPICS.
Cr. 2 to 5 each time taken. A series of one-term courses chosen from such topics as catalytic reactor design, cost estimation, chemical engineering of nuclear processes, fluidized bed reactors, crystallization, polymerization, statistical thermodynamics, applied electrochemistry, and bioengineering.
CHEMISTRY

John D. Corbett, Ph.D., Chairman of Department


Assistant Professors: Thomas J. Barton, Ph.D.; G. Vincent Calder, Ph.D.; Jon C. Clardy, Ph.D.; David K. Hoffman, Ph.D.; Dennis C. Johnson, Ph.D.; Charles J.V. Scanio, Ph.D.

Instructor: Gerald J. Small, Ph.D.

Undergraduate Study

For undergraduate curriculum in sciences and humanities or curriculum in chemistry, leading to the degree Bachelor of Science, see Sciences and Humanities, Curriculum and Chemistry, Curriculum.

Graduates in chemistry qualify in many fields: as teachers of chemistry, as analytical or control chemists, as supervisors in industry, as technical sales personnel and as research chemists in federal, state, municipal, academic, or industrial laboratories.

Undergraduate chemistry students take not only studies in chemistry but also courses in mathematics, physics, German or Russian, and in cultural subjects. Students with the necessary high scholastic standing usually continue with graduate work, where they can explore more thoroughly the specialized areas of chemistry in which they are interested.

To meet the different needs of students of chemistry, Iowa State University has two curricula, both of which lead to the degree Bachelor of Science. Both the curriculum in chemistry and the curriculum in sciences and humanities, with a major in chemistry, prepare the student for graduate study and for industrial work at the Bachelor of Science level.

Undergraduate students of chemistry in the curriculum in chemistry or in the curriculum in sciences and humanities usually have the following basic courses or their equivalents in their programs: 114, 115, 120, 224, 301, 302, 303, 316, 325, 326, 327, 330, 331, 332, 333, and 6 credits of advanced chemistry. As supporting work undergraduate majors have found the following courses desirable: Math. 110, 111, 112, 213; Phys. 221, 222, 223. These lists of courses are not to be regarded as statements of fixed requirements or as complete outlines of the work necessary for the major. They are given solely for the convenience of students or advisers who wish to estimate the amount of basic, nonspecialized study which may be needed.

Graduate Study

The department offers work for the degrees Master of Science and Doctor of Philosophy with majors in analytical, inorganic, organic, and physical chemistry and in combinations thereof. Minor work is offered to students taking major work in other departments.

In cooperation with the Institute for Atomic Research, special facilities are offered to graduate students in other departments of the University who wish to use radioactive isotopes in their research. Analytical chemistry, calculus, and physics are required for this phase of chemistry.

The Department of Chemistry requires all graduate students majoring in chemistry to teach as part of their training for an advanced degree.
Prerequisite to major graduate work is the completion of undergraduate work in chemistry, mathematics, and physics, substantially equivalent to that required of undergraduate students at this institution in the curriculum in chemistry.

Open to graduate students for minor credit only: 301, 302, 321, 322, 322L, 323, 323L, 334, 335, 336, 408, 426, 493, 494.

Index to field of work is given by the second and third figures of course numbers:

(a) Inorganic Chemistry 00 to 09
(b) Analytical Chemistry 10 to 19
(c) Physical Chemistry 20 to 29
(d) Organic Chemistry 30 to 39
(e) General Chemistry 40 to 49
(f) Open 50 to 89
(g) Special Topics 90
(h) Physical Chemistry 91 to 94
(1) Research 95 to 99

For courses in biochemistry, biophysics, and metallurgy, see Index.

COURSES PRIMARILY FOR UNDERGRADUATE STUDENTS

114. QUANTITATIVE ANALYSIS.
(3-6) Cr. 5. F.
Prerequisite: High school chemistry.
Review of fundamental principles of chemistry with emphasis on chemical equilibrium, gas laws, and calculations. Theory and practice of gravimetric and volumetric analysis with particular attention to acid-base reactions. For students majoring in chemistry or biochemistry.

115. QUANTITATIVE ANALYSIS.
(3-6) Cr. 5. W.
Prerequisite: 114 or 211.

120. CHEMICAL STRUCTURE AND BONDING.
(5-0) Cr. 5. S.
Prerequisite: 115; Math. 110.
Atomic structure, nuclear properties, and wave nature of electrons. Periodic properties of the elements. Qualitative introduction to modern understanding of chemical bonding and molecular structure in metallic and nonmetallic compounds. For chemistry majors.

140. FOUNDATIONS OF CHEMISTRY.
(4-0) Cr. 3. F.S.S.
Prerequisite: Credit or classification in 140L. Basic methods and concepts of chemistry that a student must master before he is ready for other college chemistry. For students who have not taken high school chemistry or those with otherwise deficient backgrounds. The content of this course is approximately equivalent to a 1-year high school chemistry course.

140L. LABORATORY FOUNDATIONS OF CHEMISTRY.
(0-3) Cr. 1. F.S.S.
Prerequisite: Credit or classification in 140. Laboratory to accompany 140.

*141. 142. GENERAL CHEMISTRY.
(4-0) Cr. 3 each. 141: F.W.SS; 142: W.S.SS.
Prerequisite: 141: High school chemistry or 140 and 140L. Credit or classification in 141L; 142: 141, 141L.
Principles of chemistry and properties of matter explained in terms of modern chemical theory.

*141L. 142L. LABORATORY IN GENERAL CHEMISTRY.
(0-3) Cr. 1 each. 141L: F.W.SS; 142L: W.S.SS.
Prerequisite: 141L: Credit or classification in 141; 142L: 141L.
Laboratory to accompany 141 and 142. 141L must be taken with 141; 142L is not a necessary corequisite with 142.

*147, 148. GENERAL CHEMISTRY.
(0-4) Cr. 3 each. 147: F; 148: W.
Prerequisite: 147: High school chemistry and physics with grades of B or better, rank in top 20 percent of high school class, credit or classification in 147L; 148: 147, 147L.
Chemistry explored at greater depth than in 141 and 142. May be elected by well-prepared students in all colleges. For students with strong interest in science-related fields.

*147L. 148L. GENERAL CHEMISTRY LABORATORY.
(0-3) Cr. 1 each. 147L: F; 148L: W.
Prerequisite: 147L: Classification in 147; 148L: 147L.
Laboratory to accompany 147 and 148. 147L must be taken with 147; 148L is not a necessary corequisite with 148.

211. QUANTITATIVE ANALYSIS.
(3-6) Cr. 5. F.W.S.S.
Prerequisite: 142L or 148L.
Theory and practice of elementary gravimetric, volumetric, and colorimetric analysis.

224. PHYSICAL CHEMISTRY.
(3-0) Cr. 3. S.
Prerequisite: 120, Math. 112; Phys. 112 or 222.
Elementary thermodynamics and theory of the gaseous state. Homogeneous equilibria. For students majoring in chemistry or biochemistry.

* Credits from only one of the following two series should count toward graduation:
  1. 141, 141L, 142, 142L.
  2. 147, 147L, 148, 148L.
231. ELEMENTARY ORGANIC CHEMISTRY.
(3-0) Cr. 3. F.W.S.S.S.
Prerequisite: 142L or 148L, credit or classification in 232.
For students desiring a terminal course. Not recommended for students in physical or biological sciences. Students desiring a more rigorous course should take 334, 335, and 337. Credit toward graduation will not be given for both 231 and 334.

232. LABORATORY IN ELEMENTARY ORGANIC CHEMISTRY.
A, B: (0-6) Cr. 2 each. C: (0-3) Cr. 1. F.W.S.S.S.
Prerequisite: Credit or classification in 231. A: Laboratory techniques including gravimetric analysis, volumetric analysis, and organic functions group analysis. B: Laboratory techniques in synthetic and qualitative organic chemistry. Particular emphasis on chemical and physical properties of dyes, polymers, fats, and carbohydrates. C: Condensation of material covered in 232B.

301, 302. INORGANIC CHEMISTRY.
(3-0) Cr. 3 each. 301: W; 302: S.
Prerequisite: Credit or classification in 322L. Bonding in inorganic systems; descriptive and systematic chemistry of the elements. Emphasis on correlation of structure and bonding with chemical and physical properties of inorganic compounds; applications of thermodynamics, kinetics, and other physical methods to study of inorganic systems.

303. INORGANIC CHEMISTRY LABORATORY.
(0-6) Cr. 2. S.
To accompany 302. For students majoring in chemistry or biochemistry.

309. INORGANIC CHEMISTRY REVIEW.
(3-0) Cr. 3. F.
Prerequisite: Permission of instructor. Advanced undergraduate inorganic chemistry. For students who wish to review in preparation for graduate courses.

316. QUANTITATIVE ANALYSIS.
(3-0) Cr. 5. S.
Prerequisite: 115, 326. Gas analysis. Physicochemical methods of analysis. Survey of analytical practice in chemical technology. The literature of analytical chemistry. For chemistry and biochemistry majors.

319. ANALYTICAL CHEMISTRY REVIEW.
(3-0) Cr. 3. F.
Prerequisite: Permission of instructor. For students who have already completed at least two quarters of analytical courses and who wish to review in preparation for graduate courses.

321, 322, 323. PHYSICAL CHEMISTRY.
(3-0) Cr. 3 each. 321: F.S; 322: F.W; 323: W.S.
Prerequisite: 321: 211 or 142, Phys. 223, Math. 112 recommended; 322: 321; 323: 322. Properties of gases, liquids, and solids; solutions; thermochemistry and thermodynamics; chemical kinetics; electrochemistry; atomic and molecular structure. Students majoring in chemistry or biochemistry ordinarily will elect 322, 325, 326, 327.

322L. LABORATORY IN PHYSICAL CHEMISTRY.
(0-3) Cr. 1. W.
Prerequisite: Credit or classification in 322 recommended. Should accompany 322.

323L. LABORATORY IN PHYSICAL CHEMISTRY.
(0-6) Cr. 3. S.
Prerequisite: 322L, credit or classification in 323 recommended. Should accompany or follow 323.

325. PHYSICAL CHEMISTRY.
(3-0) Cr. 3. F.
Prerequisite: 324. Heterogeneous equilibria. Electrochemistry. For students majoring in chemistry or biochemistry. Chemical engineering students will take 321, 322, 323.

326. PHYSICAL CHEMISTRY.
(3-0) Cr. 3. W.

327A, 327B. LABORATORY IN PHYSICAL CHEMISTRY.
(0-6) Cr. 3 each. 327A: F; 327B: W.
Prerequisite: 327A: 115; 327B: 327A. To accompany or follow 326 and 328. For students majoring in chemistry, chemical engineering, or biochemistry.

329. PHYSICAL CHEMISTRY REVIEW.
(3-0) Cr. 3. W.
Prerequisite: Permission of instructor. For students who have completed a year of undergraduate physical chemistry and who wish to review in preparation for graduate courses in physical chemistry.

330. LABORATORY IN ORGANIC CHEMISTRY.
(0-6) Cr. 2 each time taken. F.W.S.
Prerequisite: 115. To accompany 331, 332, 333. For students majoring in chemistry or biochemistry.

331, 332, 333. ORGANIC CHEMISTRY.
(3-0) Cr. 3 each. Yr.
Prerequisite: 331: 120; 332: 331; 333: 332 or 335. For students majoring in chemistry and biochemistry. 331, 332: Chemistry of aliphatic and aromatic compounds. Polyfunctional and heterocyclic chemistry. 333: Modern research techniques and their use in organic chemistry.

334, 335, 336. ORGANIC CHEMISTRY.
(3-0) Cr. 3 each. 334: F.W; 335: W.S; 336: S.
Prerequisite: 334 or 322L or 143L or 144 and 148L. Modern organic chemistry, including nomenclature, synthesis, structure and bonding, reaction mechanisms, physical methods, carbohydrates, proteins, and lipids. Premedical students will take this sequence. Students majoring in chemistry will ordinarily take 331, 332, 333.

337. LABORATORY IN ORGANIC CHEMISTRY.
(3-0) Cr. 2. W.S.
Prerequisite: Credit or classification in 335.

338. LABORATORY IN ORGANIC CHEMISTRY.
(3-0) Cr. 1. S.
Prerequisite: Credit or classification in 336.

339. ORGANIC CHEMISTRY REVIEW.
(3-0) Cr. 3. W.
Prerequisite: Permission of instructor. For students who have completed a year of organic chemistry and wish to review in preparation for graduate courses in organic chemistry.

399. UNDERGRADUATE RESEARCH.
Cr. arr.
Prerequisite: Permission of staff member with whom student proposes to work.

408. RADIOCHEMISTRY.
(2-6) Cr. 4. F.
Radioactivity; theory, operation, and use of radiation measuring instruments; principles of radiochemistry. For students in engineering.

426. RADIOTRACER METHODS.
(3-0) Cr. 2. F.
Prerequisite: 323 or 326 or 493; Phys. 112.
490. SPECIAL PROBLEMS.  
Cr. var.  
Prerequisite: Permission of instructor.

493, 494. BIOPHYSICAL CHEMISTRY.  
(3-0) Cr. 3 each. 493: F; 494: W.  
Prerequisite: Math. 112.  
Physical chemistry with application to biological systems. Not accepted for credit toward a degree in chemistry or chemical engineering. 322L and 323L may be taken concurrently by those desiring laboratory.

499. SENIOR RESEARCH.  
(0-6 or 9) Cr. 2 or 3 each time taken.  
Prerequisite: Permission of staff member with whom student proposes to work. B average in all chemistry, physics, and mathematics courses. Research in chosen area of chemistry, with final written report as senior thesis. This course should be elected for three consecutive quarters just preceding graduation. For students majoring in chemistry.

COURSES PRIMARILY FOR GRADUATE STUDENTS, major or minor, open to qualified undergraduates

501. INORGANIC PREPARATIONS.  
(0-6) Cr. 2. F.  
Prerequisite: 302.  
Preparation and characterization of inorganic and organometallic compounds by modern research techniques.

505. PHYSICAL PRINCIPLES OF INORGANIC CHEMISTRY.  
(3-0) Cr. 3. F.S.  
Prerequisite: 302 and 323 or 326.  
Theoretical concepts of bonding and structure applied to inorganic chemistry. Elementary group theory, hybridization and localized covalent bonding, molecular orbitals, and ligand field theory.

508. APPLICATION OF PHYSICAL METHODS IN INORGANIC CHEMISTRY.  
(3-0) Cr. 3. W.  
Prerequisite: 505.  
Spectrometric, magnetic, and diffraction measurements in inorganic and organometallic research problems. Emphasis on stereochemical and bonding information.

507. SYSTEMATIC INORGANIC CHEMISTRY.  
(3-0) Cr. 3. S.  
Prerequisite: 505, and 506 or 536 or 592.  
Descriptive chemistry of the metallic and nonmetallic elements.

511. ADVANCED QUANTITATIVE ANALYSIS.  
(3-0) Cr. 3. S.  
Prerequisite: 316, and 323 or 326, and 333 or 336.  
General methods, descriptive inorganic analysis, and current literature.

512. ELECTROCHEMICAL METHODS OF ANALYSIS.  
(2-3) Cr. 3. F.  
Prerequisite: 316, and 323 or 326, and 333 or 336.  
Principles and applications of electrochemical methods and mass spectrometry.

513. MOLECULAR ABSORPTION SPECTROPHOTOMETRY.  
(3-3) Cr. 3. W.  
Prerequisite: 316, and 323 or 326, and 333 or 336.  
Principles and analytical applications of absorption spectrophotometry.

514. ANALYTICAL ATOMIC SPECTROSCOPY.  
(2-0) Cr. 2. S.  
Prerequisite: 323 or 326; Phys. 223.  
Principles and experimental methods of optical emission spectroscopy, atomic absorption spectroscopy, and X-ray fluorescence spectroscopy.

515. ANALYTICAL ATOMIC SPECTROSCOPY LABORATORY.  
(0-6) Cr. 2. F.W.S.
COURSES FOR GRADUATE STUDENTS, major or minor

625. SELECTED TOPICS IN PHYSICAL CHEMISTRY.
(0-2) Cr. 2 each time taken. F.W.S.
Prerequisite: 521 or 592.
Topics such as atomic, molecular, and nuclear structure; surface chemistry; chemical kinetics; electrochemistry; phase rule.

626. CRYSTAL STRUCTURE ANALYSIS.
(2-0) Cr. 2 each time taken. W.S. Must be started in winter.
Prerequisite: Permission of instructor.
X-ray and neutron diffraction as applied to the solid state, kinematic theory of diffraction, space group symmetry, applications of Fourier and least-squares methods, methods for phasing structural amplitudes, examples of structures deduced from X-ray and neutron studies.

631. SEMINAR IN ORGANIC CHEMISTRY.
(1-0) Cr. 1 each time taken. F.W.S.S.S.
Prerequisite: Permission of instructor.

632. SELECTED TOPICS IN ORGANIC CHEMISTRY.
(2-0) Cr. 2 each time taken. F.W.S.S.S.
Prerequisite: 532.
Topics of current interest in organic chemistry such as electron spin resonance spectroscopy, nuclear magnetic resonance spectroscopy, mass spectrometry, physical organic chemistry, photochemistry, analytical methods, organometallic chemistry, computer techniques, modern synthetic methods, mechnisms of reductions and oxidations, carbonyl, molecular orbital theory, heterocycles, free radicals, and kinetics.

699. RESEARCH.
Prerequisite: Permission of staff member concerned.
CHILD DEVELOPMENT

Professors: Roger W. Coulson, Ph.D.; Damaris Pease, Ph.D.

Assistant Professors: Carol Anderson, M.S.; Samuel Clark, Ph.D.; Edythe K. Glass, M.S.; Albert King, M.S.; Alice F. Lillie, M.S.; Kathryn R. Madera, M.S.; Virginia Randall, M.S.

Instructors: Karen Chaloupka, M.S.; Willa Choper, M.S.; Irma Galefs, M.S.; Gordon Geddes, M.S.; Michael Jacobowitz, M.S.; Ruth M. Jones, M.S.; Shirley C. Karas, M.S.; Mark King, M.S.; Donna Nelson, M.S.; Ronald Oliver, M.S.; Dahlia Stockdale, M.S.

Undergraduate Study

For undergraduate curriculum in child development leading to the degree Bachelor of Science, see Home Economics, Curricula.

The department offers work for the degree Bachelor of Science with options in: (1) nursery school-kindergarten education, (2) community services for children, and (3) pregraduate study. Students may enroll in the nursery school-kindergarten option as sophomores but must apply to and be accepted by the departmental teacher education committee.

Child development is the systematic study of how children grow and develop. The curriculum in child development provides preparation for professional work with children and families in connection with nursery schools, kindergarten in elementary schools, hospital programs, settlement houses, welfare agencies, programs for handicapped children or emotionally disturbed children, community programs for older children and youth and special programs for disadvantaged or low income groups. Opportunities to observe and work with infants and preschool and school-age children are offered.

For further information for students wishing to combine preparation for work in journalism or radio and television with this curriculum, see Home Economics Journalism.

Graduate Study

The department offers work for the degrees Master of Science and Doctor of Philosophy with major in child development, and minor work for students taking major work in other departments.

In addition to fulfilling graduate college admission requirements, the students should have a substantial background in one of the following fields: child development, family relations, human biology, human nutrition, education, anthropology, psychology, sociology.

As a supplement to course work in major and minor fields, candidates for the degree Master of Science must exhibit proficiency in a relevant skill. To meet this proficiency requirement and with his advisory committee's approval, the student may elect one of the following alternatives: (1) reading knowledge of French, German, or Russian; (2) satisfactory completion of a two-quarter sequence in statistical methods, Educ. 552 and 553 or Stat. 401 and 402; (3) satisfactory completion of one course in psychological measurements.

Candidates for the degree Doctor of Philosophy must demonstrate a satisfactory reading knowledge of one language to be selected from French, German, or Russian.

Open to graduate students for minor credit only: 460,461.

COURSES PRIMARILY FOR UNDERGRADUATE STUDENTS

236. PRINCIPLES OF CHILD DEVELOPMENT. (3-1) Cr. 3. F.W.S.S.S1.
Prerequisite: Psych. 101.
Purposes and methods of studying growth and development. Functional synthesis of theories relating to development during the formative years. Directed observations of infants and children.

240. LITERATURE FOR CHILDREN. (4-0) Cr. 4. F.W.S.S.S1.
Prerequisite: 236.
Selection and use of literature as it contributes to the total development of children from birth through 12 years of age.

242. OBSERVATION AND PARTICIPATION IN THE NURSERY SCHOOL. (1-2) Cr. 2. F.W.S.
Prerequisite: 236. Reservation required.
Objective analysis of adult-child interactions and evaluation of feelings and attitudes, with emphasis on the professional role of the adult.

335. DEVELOPMENT IN INFANCY. (2-2) Cr. 3. F.W.S.
Prerequisite: Nine credits in child development and psychology.
Developmental characteristics during the first two years of life.

336. DEVELOPMENT IN EARLY CHILDHOOD. (3-2) Cr. 4. F.W.S.
Prerequisite: 236, Psych. 230.
Application of principles of development to children ages 2 to 6 years. Observation in the nursery school and kindergarten.

337. DEVELOPMENT AND GUIDANCE IN LATER CHILDHOOD.
(2-3) Cr. 3. F.W.S.SSII.
Prerequisite: Psych. 230.
Developmental characteristics of children from 5 to 12 years of age, with implications for guidance. Observation and participation with children.

366. ACTIVITIES AND MATERIALS.
(3-2) Cr. 4. F.W.S.SSII.
Prerequisite: 336 and either 335 or 337.
Theories of play and principles underlying the selection of activities and the use of materials for children.

368. STUDY TOUR.
Cr. R. S.
Prerequisite: Junior classification.
Visit and study various types of child and family centers, institutions, and agencies.

460. GUIDANCE OF CHILDREN.
(3-2) Cr. 4. F.W.S.SSI.
Prerequisite: 366 or E.Ed. 344.
Principles of guidance applied to children in group situations. Observation of and participation in adult-child interaction.

461. PLANNING CURRICULA FOR THE YOUNG CHILD.
(2-0) Cr. 2. F.W.S.
Prerequisite: 460.
Principles and techniques of planning curricula for groups of young children.

464. INTRODUCTION TO CHILD DEVELOPMENT RESEARCH.
(0-9) Cr. 3. F.W.S.
Prerequisite: 460, Psych. 301, senior classification.
Introduction to methods in child development research, with application to selected problems; preparation and presentation of reports.

465. SEMINAR.
(2-0) Cr. 1. F.W.S.
Prerequisite: Senior classification.
Current issues and trends in child development on a national and international scale.

467A. SUPERVISED TEACHING IN NURSERY SCHOOL-KINDERGARTEN.
(0-18) Cr. 7. F.W.S.SSII.
Prerequisite: 461, classification in 467B, 467E, 467F; cumulative grade-point average of 2.0 for students not working for certification requirements; cumulative grade-point average of 2.3 for students working for certification. Reservation required.
Experience in teaching a group of nursery school or kindergarten children for half a quarter.

467B. HOME-SCHOOL RELATIONS IN SUPERVISED TEACHING.
(2-0) Cr. 2. F.W.S.SSII.
Prerequisite: Classification in 467A, 467E, 467F.
Reservation required.
Planning and participating in home-school relations programs.

467E, 467F. SUPERVISED TEACHING IN CHILD CENTERS.
467E: (0-18) Cr. 6; 467F: (0-6) Cr. 2. F.W.S.SSII.
Prerequisite: 461, classification in 467A, 467B; cumulative grade-point average of 2.0 for students not working for certification requirements; cumulative grade-point average of 2.3 for students working for certification. Reservation required.
467E: Classification in 467F; 467F: Classification in 467E.
467E: Experience in teaching in a children's center. 467F: Intensive study of the teaching—learning situation and of an individual child.

468. ADMINISTRATION OF PROGRAMS FOR YOUNG CHILDREN.
(2-2) Cr. 3. F.W.S.
Prerequisite: Credit or classification in 460.
Essential procedures in programming for young children, including housing, equipment, health protection, and supervision. Field trips to selected children's centers.

470A. PARTICIPATION IN GROUP ACTIVITIES FOR CHILDREN.
(1-18) Cr. 7. F.W.S.SSII.
Prerequisite: 461, classification in 470B, 470E, 470F, cumulative grade-point average of 2.00. Reservation required.
Supervised participation in group activities of nursery school and after-school recreational programs.

470B. ADULT-CHILD RELATIONS.
(2-0) Cr. 2. F.W.S.SSII.
Prerequisite: Classification in 470A, 470E, 470F.
Reservation required.
Effect of adult-child relationships on development of children in a variety of community services.

470E, 470F. GROUP WORK WITH CHILDREN.
470E: (0-18) Cr. 6; 470F: (0-6) Cr. 2. F.W.S.SSII.
Prerequisite: 460, cumulative grade-point average of 2.0, classification in 470A, 470B, 470E; classification in 470F; 470F: Classification in 470E.
470E: Supervised work with children of various ages in groups and on an individual basis. 470F: Observation, interpretation, and evaluation of work with children of various ages in groups and on an individual basis.

490. SPECIAL PROBLEMS.
Cr. arr.
Prerequisite: Twelve credits in child development, permission of department head.
A. Child Development.
B. Nursery Education.
C. Community Services.
H. Honors Program.

COURSES PRIMARILY FOR GRADUATE STUDENTS, major or minor, open to qualified undergraduates

500. SHORT COURSE.
Cr. 1 to 3. SS.
Prerequisite: Permission of instructor.
Concentrated group study of various educational problems in the field of child development.

519. SELECTED RESEARCH METHODS IN CHILD DEVELOPMENT.
(3-0) Cr. 3. F.
Prerequisite: Credit or classification in Stat. 401 or Educ. 552.
Identification of research areas. Use of observation, interview, questionnaire, sociometric and rating techniques in child development research; preparation of instruments and methods of data analysis, interpretation, and dissemination of data.
### COURSES FOR GRADUATE STUDENTS

#### Major or Minor

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
<th>Prerequisite</th>
<th>Notes</th>
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<tbody>
<tr>
<td>600.</td>
<td>HISTORY AND PHILOSOPHY OF CHILD DEVELOPMENT</td>
<td>(3-0) Cr. 3. W.SSI</td>
<td>Nine credits in child development; history of child development; research centers; theories of early childhood education.</td>
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<td>601.</td>
<td>THEORIES IN THE EDUCATION OF YOUNG CHILDREN</td>
<td>(2-3) Cr. 3. S.</td>
<td>Prerequisite: Six credits in child development</td>
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<tr>
<td>602.</td>
<td>DEVELOPMENTAL APPRAISAL OF THE CHILD</td>
<td>(3-0) Cr. 3. S.</td>
<td>Prerequisite: Psych. 440</td>
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<td>603.</td>
<td>DEVELOPMENTAL PROCESSES IN CHILDREN: PHYSICAL AND MOTOR</td>
<td>(2-0) Cr. 2. Alt. S.</td>
<td>Twelve credits in child development; analysis of physical and motor development.</td>
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<tr>
<td>604.</td>
<td>DEVELOPMENTAL PROCESSES IN CHILDREN: COGNITION</td>
<td>(4-0) Cr. 4. Alt. W.</td>
<td>Twelve credits in child development; analysis of cognitive development in children.</td>
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<td>605.</td>
<td>PLANNING COLLEGE COURSES IN CHILD DEVELOPMENT</td>
<td>(3-0) Cr. 3. Alt. S.</td>
<td>Prerequisite: Six credits in child development</td>
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<td>606.</td>
<td>SEMINAR</td>
<td>Cr. arr. F.W.S.</td>
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<td>607.</td>
<td>DYNAMICS OF PARENT-CHILD RELATIONSHIPS</td>
<td>(2-0) Cr. 2. S.</td>
<td>Fifteen credits in child development and psychology</td>
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<td>608.</td>
<td>CROSS-CULTURAL STUDIES OF CHILD REARING PRACTICES</td>
<td>(3-0) Cr. 3. Alt. F.</td>
<td>Two credits in child development and psychology</td>
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#### Special Topics

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<th>Course</th>
<th>Title</th>
<th>Credits</th>
<th>Prerequisite</th>
<th>Notes</th>
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<tr>
<td>620.</td>
<td>DEVELOPMENTAL PROCESSES IN CHILDREN: PERSONALITY</td>
<td>(4-0) Cr. 4. Alt. W.</td>
<td>Twelve credits in child development; analysis of personality formation in children.</td>
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<td>621.</td>
<td>DEVELOPMENTAL PROCESSES IN CHILDREN: SOCIAL</td>
<td>(2-0) Cr. 2. Alt. S.</td>
<td>Twelve credits in child development; analysis of social development in children.</td>
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<td>622.</td>
<td>SELECTION, ORGANIZATION, AND PRESENTATION OF SUBJECT MATTER</td>
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<td>623.</td>
<td>THE GIFTED CHILD</td>
<td>(3-0) Cr. 3. W.SSI or S.SSI</td>
<td>Twelve credits in child development; characteristics of children with superior abilities and strategies for enhancing development of talent.</td>
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<td>624.</td>
<td>THE DISADVANTAGED CHILD</td>
<td>(3-0) Cr. 3. S.SSI or S.SSI</td>
<td>Twelve credits in child development; identification and analysis of problems; implications for the educative process.</td>
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<tr>
<td>625.</td>
<td>PARENT EDUCATION</td>
<td>(3-0) Cr. 3. F.</td>
<td>Two credits in child development; principles and procedures of instruction and evaluation in parent education.</td>
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<td>626.</td>
<td>PROGRAMMING FOR YOUNG CHILDREN</td>
<td>Cr. arr. F.W.S.</td>
<td>Twelve credits in child development; planning educational group experiences for young children and their families.</td>
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CIVIL ENGINEERING

Carl E. Ekberg, Jr., Ph.D., Head of Department


Assistant Professors: Theodore A. Gleason, M.S.; Sheldon Kelman, Ph.D.; F. Wayne Klaber, Ph.D.; Richard E. Montag, M.S.; Stanley L. Ring, M.S.; Ira J. Ward, M.S.; James C. Young, Ph.D.

Instructors: Eldon G. Ferguson, M.S.; Derwin C. Merrill, M.S.; Max L. Porter, M.S.

Undergraduate Study

For undergraduate curriculum in civil engineering leading to the degree Bachelor of Science, see College of Engineering, Curricula.

Civil engineering consists of the economic application of the laws, forces, and materials of nature to the planning, design, construction, maintenance, and operation of public and private facilities. Commonly included are transportation systems; bridges and buildings; water supply, pollution control, irrigation, and drainage systems; river and harbor improvements; dams and reservoirs. Civil engineering also includes the planning, design, and responsible execution of surveying operations, and the location, delimitation, and delineation of physical and cultural features on the surface of the earth. Research, testing, sales, management, and related functions are also a part of civil engineering.

Work on the campus is supplemented by inspection trips which furnish an opportunity for firsthand study of engineering work and industrial plants.

Graduate Study

The department offers work for the degrees Master of Science and Master of Engineering with majors in civil, highway, municipal, sanitary, soil, structural, and transportation engineering; for the degree Doctor of Philosophy with majors in transportation, structural, soil, and sanitary engineering; and minor work to students taking major work in other departments. Within the civil engineering major, the student may specialize in geodesy and photogrammetry.

There is no foreign language requirement for the degrees Master of Science or Master of Engineering. The department strongly recommends that all candidates for the degree Doctor of Philosophy demonstrate a significant level of proficiency in one of the following languages: French, German, Russian, or Spanish. However, with the approval of a doctoral candidate's program of study committee, 9 additional credits of course work outside the Department of Civil Engineering may be substituted for a language requirement.

Prerequisite to major graduate work is the completion of a curriculum substantially equivalent to that required of undergraduate students in civil engineering at this institution, and including undergraduate courses necessary for the particular field chosen.

Students who major in civil engineering usually will select minor work from the departments of Mathematics, Physics, Chemistry, Bacteriology, Geology, Economics, Statistics, or other engineering departments.

COURSES PRIMARILY FOR UNDERGRADUATE STUDENTS

100. TECHNICAL LECTURE.  
(1-0) Cr. R; 6. 
Discussion of various phases of civil engineering. Lectures by staff members and practicing civil engineers.

210. SURVEYING.  
(2-9) Cr. 5, F.  
Prerequisite: Math. 109. 
Surveying for resource development including principles of surveying measurements, topography, traversing, plane table mapping, field astronomy, and staking of buildings, curves and earthwork.

211. 211A. ELEMENTARY SURVEYING.  
(1-6) Cr. 3, F.  
Prerequisite: 211: Math. 109; 211A: Competence in algebra and trigonometry. 
Principles of surveying measurements, simple topography, site layout and traversing. 211A: Primarily for students in the College of Agriculture.

212. PHOTOGRAMMETRY, MAPPING AND LAND SURVEYING.  
(2-3) Cr. 3, W.  
Prerequisite: 211. 
Introduction to photogrammetry. Mapping from stadia and aerial surveys. Land surveying.

213. ROUTE AND HIGHER SURVEYING.  
(1-6) Cr. 3, S.  
Prerequisite: 212. 
Theory and practice in curves, earthwork problems, and surveying astronomy.

214. PHOTOGRAMMETRY, ROUTE AND LAND SURVEYING.  
(1-6) Cr. 3, W.  
Prerequisite: 210 or 211. 
Introduction to mapping and photogrammetry. Simple curves and earthwork. Elementary public and private land surveys.

304. HYDROLOGY.  
(2-3) Cr. 3, W.S.SS.  
Prerequisite: Com. S. 201, Stat. 105. 
Elements of hydrology, precipitation, water losses, stream flow and ground water hydraulics.

331. ANALYSIS OF STATICALLY DETERMINE STRUCTURES.  
(3-0) Cr. 3, F.W.  
Prerequisite: E.M. 324, or classification in E.M. 326. 

331A. ANALYSIS OF STATICALLY DETERMINE STRUCTURES.  
(3-0) Cr. 3, F.S.  
Prerequisite: E.M. 325. 

350. COLLABORATIVE TRANSPORTATION DEVELOPMENT.  
(3-0) Cr. 3, F.S.  
Prerequisite: Junior classification. 
History, legal requirements, organizations, and coordination in national, state, and local development of transport modes. The planning, regulation, safety, operation, and circulation patterns of air, rail, water, pipeline, street, and road systems. Population, land use, economic, social, and other source data for use in the location of transportation routes, parking, and terminal facilities.

352. PLANNING OF TRANSPORTATION FACILITIES.  
(3-0) Cr. 3. W.S.SS.  
Prerequisite: Credit or classification in 213 and Stat. 105. 
Introduction to planning for systems of highway, rail, air, water, and pipeline transportation. Selection of route and mode based on economic and financial factors, technological characteristics, and other factors. Transportation terminals.

360. SOIL ENGINEERING.  
(3-0) Cr. 3, F.S.  
Prerequisite: Geol. 301, credit or classification in E.M. 324. 
Introduction to basic soil engineering; soil structure, soil mineralogy, soil water systems, and interactive forces; principles of settlement and shear stresses in soils; application of soil engineering in embankments, retaining walls, foundations, piles and underground conduits.

361. SOIL AND AGGREGATE MATERIALS LABORATORY.  
(0-6) Cr. 3. W.  
Prerequisite: Geol. 301, credit or classification in E.M. 324. 
Testing, identification, and classification tests of engineering soils and aggregates. Physical and chemical properties tests of soil-granular systems.

362. DESIGN OF CONCRETES AND STABILIZED SOIL SYSTEMS.  
(0-6) Cr. 3, S.  
Prerequisite: 361, E.M. 354. 
Physical and chemical properties of bituminous, portland, and other cements. Design and testing of concretes and stabilized soil systems. Admixtures. Mixing, handling, placing, and curing.

394, 396, 399. PROFESSIONAL DEVELOPMENT.  
Cr. R; 394: F; 395: W.  
Oral reports and discussions of prominent engineers, notable engineering projects and related topics.

404. ENGINEERING IN CITY PLANNING.  
(3-0) Cr. 3. W.  
Prerequisite: 350, Ur. Pl. 270 or C.E. 426 and 453. 
Relation of sanitary works, transportation, and other utilities to city planning; housing, building codes, real estate subdivision, land titles.

415. GEODETIC SURVEYING.  
(2-3) Cr. 3, F.  
Prerequisite: 213 or 214 or Geol. 302. 
Geodetic control surveys. Precise triangulation, trilateration, traversing, and leveling. Geodetic computation on the ellipsoid. Design of geodetic surveys for various applications. Introduction to adjustment theory.

416. PRINCIPLES OF GEODESY.  
(3-0) Cr. 3, S.  
Prerequisite: 213 or 214 or Geol. 302. 

417A, 417B. LAND SURVEYING.  
417A: (1-6); 417B: (3-0) Cr. 3 each. S.  
Prerequisite: 417A: 213; 417B: Credit or classification in 417A.

418. PHOTOGRAMMETRY I. (2-3) Cr. 3. W.
Prerequisite: 212 or 214 or Geol. 204.

425. SANITARY ENGINEERING I. (2-3) Cr. 3. F.W.
Prerequisite: Chem. 142, Math. 213, Phys. 221.
Introduction to those studies in which engineering knowledge is applied to problems concerning public health, including water and waste water treatment, the prevention and control of air pollution, stream pollution, and communicable diseases.

426. SANITARY ENGINEERING II. (2-6) Cr. 4. F.W.
Prerequisite: 304, 425, E.M. 378.
Engineering aspects of collection, pumping, storage, and distribution of water for public, domestic and industrial uses; and collection of storm, sanitary, and combined waste water. Design of systems.

427. SANITARY ENGINEERING III. (2-3) Cr. 3. S.
Prerequisite: 426.
Extension of principles presented in 425 and 426 and application to integrated water supply or pollution-control design problems.

428. SANITARY ENGINEERING IN PUBLIC HEALTH. (3-0) Cr. 3. W.
Prerequisite: 425.
The sanitary engineer's responsibility in public health and hygiene. Organization, administration, and operation of public health agencies.

432. ANALYSIS OF STATICALLY INDETERMINATE STRUCTURES. (4-0) Cr. 4. W.S.
Prerequisite: 331, Com. S. 201.
Analysis of continuous beams and frames by consistent deformations, slope deflection, moment distribution. Truss analysis by virtual work. Application of loading criteria.

432A. ANALYSIS OF STATICALLY INDETERMINATE STRUCTURES. (4-0) Cr. 4. F.W.
Prerequisite: 331.

433. STRUCTURAL STEEL DESIGN. (3-0) Cr. 3. F.S.
Prerequisite: 432, Math. 213, E.M. 327, 354.
Design and behavior of the elements of steel structures, proportioning of members and connections, introduction to plastic design.

433A. STRUCTURAL STEEL DESIGN. (4-0) Cr. 4. W.S.
Prerequisite: 432A, and Arch. 343 or E.M. 327 and 354.

434. REINFORCED CONCRETE DESIGN. (5-0) Cr. 3. F.W.
Prerequisite: 432, Math. 213, E.M. 327, 354.
Design and behavior of elements of reinforced concrete structures such as beams, columns, footings, and slabs.

434A. REINFORCED CONCRETE DESIGN. (4-0) Cr. 4. F.S.
Prerequisite: 432A, and Arch. 343 or E.M. 327 and 354.

448. ADVANCED STEEL STRUCTURES. (3-0) Cr. 3. S.
Prerequisite: 433, credit or classification in Math. 321.
Plastic design; built-up beams and girders; composite design; metal folded plates and domes; design considerations for fatigue, bracing, and connections; structural systems.

449. ADVANCED REINFORCED CONCRETE STRUCTURES. (3-0) Cr. 3. S.
Prerequisite: 434, credit or classification in Math. 321.
One-way slab, beam, and girder floors; two-way and flat slabs; building frames; footings; retaining walls; introduction to prestressed concrete.

450. TRAFFIC ENGINEERING. (3-3) Cr. 4. W.
Prerequisite: 352.

451. TRAFFIC PLANNING. (3-2) Cr. 4. S.
Prerequisite: 350 or 450.
Planning of highway systems and terminals considered as a part of the complete planning approach; traffic studies, projections, analysis, plan formulation, and programming.

453. DESIGN OF TRANSPORTATION FACILITIES. (3-3) Cr. 4. F.S.
Prerequisite: 304, 352, 362, E.M. 378.
Location and safe geometric design of highway facilities. Earthwork and drainage related to highway, railway and airport design. Design, construction, and maintenance of pavements and stabilized bases.

460. FOUNDATIONS. (3-0) Cr. 3. S.
Prerequisite: 360.

472. APPLIED HYDRAULIC DESIGN. (2-2) Cr. 3. S.
Prerequisite: 304, E.M. 378.
Characteristics of flow in natural and artificial channels; hydraulic design of culverts, bridge waterway openings, spillways, stilling basins, hydraulic gates and gated structures, miscellaneous water control structures.
485. ENGINEERING CONSTRUCTION.
(2-2) Cr. 3. F.W.S.
Prerequisite: Credit or classification in E.M. 364.
Quantity surveys, cost keeping, letting procedures, and contract documents, form design, construction methods, and equipment. Relations between contractor, owner, and engineer.

486. CIVIL ENGINEERING SPECIFICATIONS.
(3-0) Cr. 3. S.
Prerequisite: Stat. 106, credit or classification in I.A.D. 365A or I.E. 480. The preparation of specifications for structures, highway, and public works development.

COURSES PRIMARILY FOR GRADUATE STUDENTS, major or minor, open to qualified undergraduates:

506. PUBLIC WORKS ENGINEERING.
(3-0) Cr. 3. S.
Prerequisite: 427. Job classification and specification; construction contracts and specifications; unit costs; special assessments; building codes; fire protection; refusal collection and disposal; street and work maintenance; subdivision design and layout.

510. PHOTOGRAMMETRY II.
(2-3) Cr. 3. Alt. F. offered 1971.
Prerequisite: 418 or For. 445. Advanced theory of, and practice with Multiplex and Kelsh-type plotters. Theory of higher order planar, Advanced parallel theory; model deformations. Accuracies of relative orientation and elevation determinations.

511. SURVEYING USING ELECTRONIC INSTRUMENTS.
Prerequisite: 415, Phys. 223. Fundamentals of electronic surveying with the geodimeter, tellurometer, hiran and similar electronic systems. Geometric design of system layouts involving hyperbolic positioning, airborne line-crossing, and satellite methods. Theory and practice in electronic trilateration.

512. GEODETIC ASTRONOMY.

513. ADJUSTMENT OF OBSERVATIONS.

515. ADVANCED GEOMETRIC GEODESY.
(3-0) Cr. 3. Alt. F. offered 1971.

516. ANALYTICAL PHOTOGRAMMETRY.

518. PHYSICAL GEODESY.
(3-0) Cr. 3. Alt. W, offered 1972.

520. WATER AND WASTE WATER ANALYSIS.
(0-9) Cr. 3 to 6. W.
Prerequisite: 425, and Chem. 211 or 114. Review of the principles of gravimetric, volumetric, and colorimetric methods of analysis. Application of these principles to the laboratory analysis of water and waste water samples.

522. WATER POLLUTION CONTROL PLANT DESIGN.
(2-3) Cr. 3. S.
Prerequisite: Biol. 101, credit or classification in 427. Investigation and planning activities used to evaluate need for water pollution control facilities and design of such facilities.

523. WATER TREATMENT PLANT DESIGN.
(2-3) Cr. 3. W.
Prerequisite: 426, credit or classification in Chem. 211. Investigation and planning activities used to evaluate adequacy of existing municipal water supply and treatment facilities. Design of municipal water treatment facilities.

525. PHYSICAL-CHEMICAL TREATMENT PROCESSES.
(2-3) Cr. 3. S.
Prerequisite: 426, and Chem. 114 or 211. Principles of important processes in water and waste treatment. Applications of these principles to solve specific treatment problems. Studies in adsorption, ion exchange, reverse osmosis, and electrodialysis.

528. FUNDAMENTALS OF BIOLOGICAL WASTE TREATMENT.
(2-3) Cr. 3. F.
Prerequisite: 520, Chem. 334, Bact. 300. Relationship of the fundamentals of biological growth to the design and operation of biological waste-treatment systems. Characterization of wastes relative to their treatability and the selection of appropriate processes for their treatment.
532. LOW-LEVEL RADIOACTIVE WASTES.  
(3-0 to 5) Cr. 3 to 6. S.  
Prerequisite: Nuc.E. 510 or Chem. 408.  
Sources of radioactive wastes. Principles of handling, treating, and disposing of low-level wastes which arise from nuclear energy operations.

533. STRUCTURAL ANALYSIS BY NUMERICAL PROCEDURES.  
(3-0) Cr. 3. W.  
Prerequisite: 433, Math. 321, E.M. 345.  
Analysis of structural problems by methods of successive approximations and numerical procedures; moments and deflections of beams, influence lines, moments and deflections of beams under combined axial and bending loads, buckling strength of columns and frames, beams on elastic foundations.

534. STRUCTURAL ANALYSIS BY MATRIX METHODS.  
(3-0) Cr. 3. S.  
Prerequisite: 432, Math. 321.  

535. ADVANCED STRUCTURAL ANALYSIS.  
(3-0) Cr. 3. F.  
Prerequisite: 432, credit or classification in Math. 321. Analysis of framed structures by force and displacement methods; energy principles; treatment of nonprismatic members, semi-rigid connections, foundation settlements, temperature changes, composite structures.

536. BRIDGE DESIGN.  
(3-0) Cr. 3. S.  
Prerequisite: 433, 434, Math. 321.  
Superstructure and substructure design. Design of simple span and continuous span bridges, including slab, beam and slab, and truss types. Introduction to orthotropic steel plate deck bridges.

537. MODEL ANALYSIS OF STRUCTURES.  
(2-3) Cr. 3. W.  
Prerequisite: 433, 434, Math. 321, 322. Theoretical and experimental model analysis of structures. Use of devices and mechanisms for measuring load effects on plane and space structures.

538. PRESTRESSED CONCRETE STRUCTURES.  
(3-0) Cr. 3. W.  
Prerequisite: 434, Math. 321.  
Principles of prestressed concrete with applications to structural design.

539. BEHAVIOR OF REINFORCED CONCRETE MEMBERS.  
Cr. 3 to 6. F.  
Prerequisite: 434, credit or classification in Math. 321. Behavior and strength of reinforced concrete members by reviews of experimental and analytical investigations; flexure, axial load, shear, bond, torsion; combined loadings.

540. PLASTIC ANALYSIS AND DESIGN OF STRUCTURES.  
(3-0) Cr. 3. W.  
Prerequisite: 433, Math. 321.  

541. BEHAVIOR OF METAL STRUCTURES.  
(3-0) Cr. 3. W.  
Prerequisite: 433, Math. 321. Study of the behavior of metals, connections, members, and structures; relation between results of research and current specifications for design.

542. ADVANCED STRUCTURAL DESIGN IN METALS.  
(3-0) Cr. 3. S.  
Prerequisite: 448. Study of the theories of analysis of the behavior of structural metal members and the interpretation of specifications for the design of buildings and bridges.

543. PLATE AND SHELL TYPE STRUCTURES I.  
(3-0) Cr. 3. S.  
Prerequisite: 434, E.M. 514, Math. 322.  

544. HIGHWAY ECONOMICS AND FINANCE.  
(3-0) Cr. 3. F.  
Prerequisite: 352 and Econ. 242; or Econ. 405 or I.Ad. 463 or I.E. 304. Highway revenue sources, apportionment to different levels of government, allocation of taxation between highway users and nonusers and among classes of users. Principles of economic analysis for highway improvements, pertinent market and nonmarket benefits and costs, methods of analysis.

545. TRAFFIC ENGINEERING PLANNING AND ANALYSIS.  
(3-0) Cr. 4. F.  
Prerequisite: Credit or classification in 463. Human and vehicular characteristics related to traffic; traffic characteristics; highway capacity; traffic studies and analysis of data; principles of traffic planning, forecasting techniques, and mass-transit planning.

546. TRAFFIC ENGINEERING DESIGN AND CONTROL.  
(3-3) Cr. 4. W.  
Prerequisite: 553. Principles of street and highway traffic design for safety and control, arterial ways, one-way streets, traffic signals, signs, markings and lighting, channelization, speed regulation and zoning.

547. HIGHWAY AGENCY ADMINISTRATION AND MANAGEMENT.  
Cr. 3. F.  
Prerequisite: 352 or Pol.S. 471. Organization of the highway function at national, state, and local levels; administrative procedures for highway planning, design, construction, operation, and maintenance. Management principles applicable to the highway function of governments and public authorities.

548. DESIGN OF AEROSPACE TRAFFIC AND TRANSPORTATION FACILITIES.  
(3-3) Cr. 4. S.  
Prerequisite: 463. Historical development, legislation, finance, zoning and operation of aerospace transport facilities. The installation of lighting and electronic traffic aids for taxiways, runways, approaches and airways. The planning, location and design of airports, terminals, and spaceports.

550. SOIL MECHANICS I.  
(3-0) Cr. 3. F.  
Prerequisite: 360. Advanced treatment of theory and principles of engineering soil mechanics as related to permeability, capillarity, seepage forces, stress distribution, effective stresses, and shear strength.

551. SOIL MECHANICS II.  
(3-0) Cr. 3. W.  
Prerequisite: 550A. Advanced soil mechanics. Slope stability, earth pressures, bearing capacity, piles, and under­ground conduits.
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562. AIRPHOTO INTERPRETATION OF ENGINEERING SOILS.
(2-6) Cr. 4. S.
Prerequisite: 360 and Geol. 301 or 302.
Recognition, identification, and mapping of engineering soils from airphoto. Site evaluation; material reconnaissance; principles and applications of infrared, radar, microwave technology: field checking.

563. ADVANCED SOIL ENGINEERING LABORATORY.
(2-3) Cr. 3. W.
Prerequisite: 565.
Analysis of engineering soils and crystalline materials by X-ray diffraction, differential thermal, and thermogravimetric methods.

564. ADVANCED SOIL ENGINEERING LABORATORY.
(1-6) Cr. 3. S.
Prerequisite: 560A.
Triaxial shear, consolidation, permeability, capillarity testing and analyses; relation of hydrostatic excess pressures to compositional influences. Field load tests.

565. STABILITY OF SOIL MATERIALS.
(3-0) Cr. 3. F.
Prerequisite: 360, 362.
Physico-chemical factors affecting soil stability; clay minerals, clay colloids; effect of chemical additives such as portland cement, lime salts, and resins.

566. CONCRETE MATERIALS.
(3-3) Cr. 4. F.
Prerequisite: 362, E.M. 364.

568. BITUMINOUS PAVING MATERIALS.
(3-3) Cr. 4. F.
Prerequisite: 362.
Source, manufacture, processing, types, constituents, tests, chemical behavior, specifications, and uses of bituminous materials and aggregates in pavement. Laboratory tests.

569. PAVEMENT DESIGN.
(3-0) Cr. 3. W.
Prerequisite: 567, 568.
Design of flexible and rigid pavements.

571. FIELD HYDROLOGY.
(2-3) Cr. 3. F.
Prerequisite: 304, E.M. 378.
Collection and analysis of field data concerning precipitation, water table and stream flow. Use of current hydrologic techniques in hydrologic studies.

573. GROUND WATER HYDROLOGY.
(3-0) Cr. 3. S.
Prerequisite: 304, E.M. 378.
Study of ground water as a source of municipal, industrial, and agricultural water supplies; location, occurrence, hydraulic of flow; determination of aquifer and well characteristics, well discharge and pumping test analysis.

574. MULTIPLE USE OF WATER RESOURCES.
(2-3 to 12) Cr. 3 to 6. W.
Prerequisite: 304.
Social, economic, and technical phases of governmental participation in public works programs in the field of water resources. Study of multipurpose uses in water resources project planning.

576. HIGHWAY CONSTRUCTION METHODS.
(2-2) Cr. 3. F.
Prerequisite: 362, credit or classification in 485.
Methods and equipment used in processing materials and constructing highways and their appurtenances; scheduling and controlling operations; compliance with specifications.

586. HEAVY CONSTRUCTION METHODS.
(3-0) Cr. 3. W.
Prerequisite: Credit or classification in 485.
Methods and equipment employed in heavy construction including pile, caissons, heavy foundations, piers, cofferdams and river works, heavy concrete structures, retaining walls, tunneling, and dam projects.

590. SPECIAL TOPICS.
Cr. 1 to 5 each time elected.

An undergraduate student must have an academic standing in the upper one-half of his class in order to enroll in any 500 level civil engineering course.

COURSES FOR GRADUATE STUDENTS, major or minor

622. ADVANCED TOPICS IN WATER POLLUTION CONTROL.
Cr. 3 to 6. Alt. F., offered 1972.
Prerequisite: 524.
Study of advanced concepts in water pollution control. Analysis and application of current developments to pollution control methods.

623. ADVANCED TOPICS IN WATER TREATMENT.
Cr. 3 to 6. Alt. F., offered 1971.
Prerequisite: 523.
Study of advanced concepts in water treatment. Analysis and application of current developments to water treatment methods.

634. CABLE-SUPPORTED STRUCTURES.
(3-0) Cr. 3. W.
Prerequisite: 534, E.M. 345.
Comparison of analyses by elastic theory, conventional deflection theory, and difference equation methods as applied to suspension bridges. Consideration of other types of cable-supported structures.

644. SPACE FRAMES.
Cr. 3 to 6. F.
Prerequisite: 534.
Analysis of complete structures in three planes, including the continuous-frame and the truss-frame types.

646. DYNAMIC ANALYSIS OF STRUCTURES.
Cr. 3 to 6. S.
Prerequisite: 533 or 534; E.M. 345.
Single and multi-degree systems, linear and nonlinear systems, arbitrary disturbances, continuous and lumped mass systems, numerical and phase plane solutions, modal analysis, formulation by flexibility and stiffness matrices, response spectra, analysis and design for earthquake, wind, nuclear blasts, and moving vehicles.

648. PLATE- AND SHELL-TYPE STRUCTURES II.
(3-0) Cr. 3. F.
Prerequisite: 547.

653. STREET AND URBAN HIGHWAY DESIGN.
(3-3) Cr. 4. W.
Prerequisite: 553.
Design of city streets, involving cross section, intersections, subsurface utilities, on- and off-
street parking, mass transportation, loading facilities, widening, channelization, drainage, and markings; design of urban expressways, service roads and their relationship to basic street system.

654. HIGHWAY LOCATION AND DESIGN. Cr. 4. S. Prerequisite: 554. Route selection, geometric design, economic aspects, traffic capacity, and roadway appurtenances of nonurban roads and highways.

656. PLANNING TRANSPORTATION SYSTEMS. Cr. 3. Alt. S. offered 1973. Prerequisite: 553. Fundamentals and coordination of transportation systems. Regional planning, planning surveys, designation of road and street systems. Mass transportation and location and type of urban facilities.

660. FOUNDATIONS AND UNDERGROUND STRUCTURES. (3-0) Cr. 3. S. Prerequisite: 560B. Advanced foundation analysis and design to meet various soil conditions. Review of recent literature, field investigation, case histories.

663. EARTH DAMS. (3-0) Cr. 3. Alt. S. offered 1972. Prerequisite: 560B. Location, selection of material, design, and construction of earth dams. Field trips.

664, 665, 666. STABILITY OF SOILS AND GRANULAR MATERIALS. (3-0) Cr. 3. Alt. Yr. offered 1972-73. Prerequisite: 565. Granulometry and colloid chemistry as related to soil plasticity classification, strength, and mix design. Use of chemical stabilizers, pozzolans, and portland cement.

669. ADVANCED PAVEMENT DESIGN. (3-0) Cr. 3. Alt. S. offered 1973. Prerequisite: 566. Recent developments in the theories of flexible and rigid pavement design. Test road evaluations.

671. ADVANCED TOPICS IN WATER RESOURCES ENGINEERING. (A.E. 671) (3-0) Cr. 3. Alt. S. offered 1972. Prerequisite: 671; 472 or A.E. 424; Stat. 401. Study of advanced concepts and experimental techniques used in solving water resources engineering problems. Application of simulation methods, mathematical models and advanced research methods in areas of hydrology, hydraulics of water control facilities, and water-resources development.

691. SEMINAR. Cr. R.

699. RESEARCH.

CLIMATOLOGY

For program in agricultural climatology, see College of Agriculture, Curriculum in Agronomy and Agronomy, Courses and Programs.

COMPUTER SCIENCE

Robert M. Stewart, Jr., Ph.D., Chairman of Department


Associate Professors: Harrington C. Brearley, Jr., Ph.D.; Dale Grosvenor, Ph.D.; Howard W. Jespersen, M.S.; Roy F. Keller, Ph.D.; C.C. Mosier, B.S.; Arthur V. Pohm, Ph.D.; Donald H. Schuster, Ph.D.; John D. Stevens, Ph.D.; Roy Zingg, Ph.D.

Assistant Professors: Norman E. Hutton, D.V.M.; Arthur E. Oldehoeft, Ph.D.; Wayne O. Ostendorf, B.S.; Stefan M. Silverston, Ph.D.; Rex A. Thomas, Ph.D.; Dean Ulrichson, Ph.D.; Charles T. Wright, Jr., Ph.D.

Instructors: Michael D. Bowman, B.S.; Joan F. Silverston, M.A.; June F. Smith, B.S.

Undergraduate Study

For undergraduate curriculum in sciences and humanities, major in computer science, leading to the degree Bachelor of Science, see Sciences and Humanities, Curriculum.

The curriculum in sciences and humanities with a major in computer science is designed to prepare students for graduate study in computer science or for positions as computer scientists with business, industry, or government. Areas of emphasis exist in programming language structure, systems programming, numerical analysis, statistics, and computer systems engineering.

The requirements for an undergraduate major in computer science include: (1) 21 credits in computer science at the 300 level or above, to be specified by the Department of Computer Science, (2) at least 9 additional credits in computer science at the 300 level or above, to be
selected by the student in a manner consistent with his objectives, and (3) at least 18 credits in mathematics starting with Math. 110, with the balance to be selected from an approved list specified by the Department of Computer Science.

The following courses are not acceptable for major credit by computer science majors: 447, 470, 471, 484.

Graduate Study

Work is offered for the degrees Master of Science and Doctor of Philosophy with major in computer science. Minor work is offered to students taking major work in other areas.

Facilities exist for fundamental research in such areas as numerical solution of ordinary and partial differential equations, computational methods in linear algebra, the theory of approximation, logical design and programming systems, switching theory, the theory of computer organization, programming language theory, and computer-assisted instruction.

A student desiring to do graduate work with a major in computer science should have completed a bachelor's degree or equivalent in computer science or in a related area such as mathematics, statistics, physics, or electrical engineering. He should have a strong background in mathematics including some work in algebra, analysis, logic, and probability. Students who do not have these prerequisites should plan to complete them in addition to the regular course requirements for the advanced degree.

For the degree Master of Science, 45 quarter credits are required. Normally this is all in course work, but in some cases it will include preparation of a thesis recommended by the student's committee. If no thesis is presented, the preparation of a paper demonstrating ability to organize and express significant ideas in computer science is required. There is no foreign language requirement.

For the degree Doctor of Philosophy, the foreign language requirement may be satisfied in one of two ways: (1) Significant competence in one language. This competence may be evidenced by satisfactory completion of two years of college level study of the language. (2) Reading ability in two languages. Ability in each language may be evidenced by satisfactory completion of one year of college level study of the language. In exceptional cases the candidate's committee may authorize the passing of a standardized foreign language examination in lieu of a formal college-level course in the language.

The languages will normally be selected from French, German, or Russian, although the candidate's committee may authorize other choices. The committee of a student whose native language is not English may substitute the ability to communicate in English for one of two languages.

The Department of Computer Science recommends that all graduate students majoring in computer science teach as part of their training for an advanced degree.

Additional work is usually required in mathematics, statistics, electrical engineering, or certain other fields.

Courses open to graduate students for minor credit: 301, 350, 356, 357, 441, 442, 443, 447, 451, 452, 453, 468, 470, 471, 484, 490, 495.

COURSES PRIMARILY FOR UNDERGRADUATE STUDENTS

100. PERSPECTIVES IN COMPUTING.
(2-0) Cr. 2 W.
Computer systems and programming languages with emphasis on the relationship of computing to other fields of human activity. Not to be taken with or after 201. Offered on a satisfactory-fail basis only.

201, 202, 203. COMPUTER PROGRAMMING.
(2-2) (2-2) (3-0) Cr. 3 each. 201: F.W.S.SSI; 202: W.S.; 203: F.S.SSI.
Prerequisite: 201: Math. 104 or 109, sophomore standing; 202: 201; 203: 202.
Introduction to computer organization and programming concepts, flow charts, algorithms, programming in procedure-oriented languages, elementary data structures, considerations of efficiency of programs, debugging, and verification of programs. 201 is suitable as an introductory one-quarter programming course.

301. MACHINE AND ASSEMBLY LANGUAGE PROGRAMMING.
(3-0) Cr. 3 F.S.
Prerequisite: 202.
Introduction to digital computer structure and machine language programming, internal representation of data, assembly language.

350. INFORMATION STRUCTURES.
(3-0) Cr. 3 F.S.
Prerequisite: 203.
Study of information representations and relationship between the form of representations and processing techniques. Transformations between storage media; referencing of information
as related to the structure of its representation. Concepts of functions, arrays, records, files, trees, list and list structures.

356. COMPUTER SYSTEMS I.
   (3-0) Cr. 3. F.W.
   Prerequisite: 301.
   Assembly systems, storage allocation and protection techniques, executive systems—structures, generation and maintenance; priority and scheduling techniques for batch processing.

357. COMPUTER SYSTEMS II.
   (3-0) Cr. 3. W.S.
   Prerequisite: 356.
   Executive systems for multiprogramming and multiprocessing, input-output control, dynamic storage allocation, interrupts, program library maintenance and up-dating, time-sharing systems.

380. STATISTICAL APPLICATIONS OF DIGITAL COMPUTERS.

406. INTRODUCTION TO NUMERICAL TECHNIQUES FOR COMPUTERS.
   (Math. 406) See Mathematics.

407, 408. NUMERICAL ANALYSIS I, II.
   (Math. 407, 408) See Mathematics.

410. INTRODUCTION TO SWITCHING THEORY.
   (E.E. 410) See Electrical Engineering.

411, 412. PRINCIPLES OF COMPUTER DESIGN.
   (E.E. 411, 412) See Electrical Engineering.

441. COMPUTER-ORIENTED BUSINESS DATA SYSTEMS I.
   (2-3) Cr. 3. F.
   Prerequisite: Credit or classification in I.Ad. 384. Mosler, Ostendorf.
   Introduction to computer techniques for business data processing. Use of COBOL programming language in simple problems, payroll, inventory control, etc.

442. COMPUTER-ORIENTED BUSINESS DATA SYSTEMS II.
   (2-3) Cr. 3. W.
   Prerequisite: 441 and credit or classification in I.Ad. 385. Ostendorf.
   Application of computer programming and systems to business data processing; file organization, development, and control; sequential and random processing and exception reporting.

443. COMPUTER-ORIENTED BUSINESS DATA SYSTEMS III.
   (2-3) Cr. 3. S.
   Prerequisite: 442. Ostendorf.
   Advanced data systems concepts and processing techniques. On-line, off-line systems and controls; computer language and operating systems considerations in business data processing; Pert CPM and management game concepts.

447. INTRODUCTION TO COMPUTERS FOR THE BIOLOGICAL RESEARCH WORKER.
   (V.Pth. 447) (3-0) Cr. 3. F. Hutton.
   Data coding and use of unit record equipment. Logical basis of a digital computer system. The programming of data editing and record keeping procedures will be taught using a higher level language.

451. ALGEBRAIC LANGUAGES AND COMPILERS I.
   (3-0) Cr. 3. F.W.
   Prerequisite: 202. Keller.
   Introduction to languages in general, formal language structure (syntax and semantics).

452. ALGEBRAIC LANGUAGES AND COMPILERS II.
   (3-0) Cr. 3. W.S.
   Prerequisite: 451. Keller.
   Study of Backus Normal (Naur) Form and introduction to compiling; compiler construction; analyzer algorithms.

453. ALGEBRAIC LANGUAGES AND COMPILERS III.
   (3-0) Cr. 3. S.
   Prerequisite: 452. Keller.
   Compiling techniques, code generation.

468. PROBLEM FORMULATION IN NON-NUMERIC PROCESSES.
   (3-0) Cr. 3. W.
   Prerequisite: 350.

470. INTRODUCTION TO DATA PROCESSING AND PROGRAMMING FOR BEHAVIORAL SCIENCES.
   (3-0) Cr. 3. F.
   Prerequisite: Stat. 401.
   Concepts and procedures. Punch card concepts, data organization and collection, storage media, and computer organization. Program organization and flowcharting techniques. Primarily for research workers in behavioral sciences.

471. DATA PROCESSING AND PROGRAMMING FOR BEHAVIORAL SCIENCES.
   (3-0) Cr. 3. W.
   Prerequisite: 470.
   Use of data-processing techniques and the computer as research tools. Higher-level language programming and use of mathematical and statistical library programs.

481, 482. PROCESSING OF STATISTICAL DATA.
   (Stat. 481, 482) See Statistics.

484. COMPUTER TECHNIQUES FOR BIOLOGICAL RESEARCH.
   (3-0) Cr. 3. S.
   Prerequisite: 201, Stat. 401.

480. SPECIAL PROBLEMS.
   Cr. var.
   Prerequisite: Permission of instructor.
   H. Honore Program.

485. SEMINAR.
   Cr. var. F.W.S.

COURSES PRIMARILY FOR GRADUATE STUDENTS, major or minor, open to qualified undergraduates

501, 502, 503. PROGRAMMING LANGUAGES AND SYSTEMS.
   (3-0) Cr. 3 each. Yr.
   Prerequisite: 453.
   Formal approach to programming languages.

507, 508. NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS.
   (Math. 507, 508) See Mathematics.

509. COMPUTATIONAL METHODS OF LINEAR ALGEBRA.
   (Math. 509) See Mathematics.
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524, 525. THEORY OF AUTOMATA.
(Math. 524, 525) See Mathematics.

551, 552, 553. STRUCTURE AND PROCESSING OF INFORMATION.
(3-0) Cr. 3 Yr.
Prerequisite: 350. Jespersen.
Formalisms necessary to represent the structure and manipulation of information. Information coding for storage and retrieval, fixed and variable length information records; vectors and arrays; trees and list structures. Processing of structured information. Search, sort, and merge operations involving the characteristics of the storage media available in a computer system. Characteristics of programming languages for processing information structures; study of at least one current information processing language.

580, 581. SCIENTIFIC APPLICATION OF DIGITAL COMPUTERS. I, II.

582. SWITCHING THEORY.
(E.E. 582) See Electrical Engineering.

584, 585. DIGITAL SYSTEM ORGANIZATION.
(E.E. 584, 585) See Electrical Engineering.

586. DIGITAL SYSTEM DESIGN.
(E.E. 586) See Electrical Engineering.

590. SPECIAL TOPICS.
Cr. var.
Prerequisite: Permission of instructor.

COURSES FOR GRADUATE STUDENTS, major or minor

607. ADVANCED TOPICS IN NUMERICAL ANALYSIS.
(Math. 607) See Mathematics.

610. SEMINAR.
Cr. var. Offered on demand.

680. ADVANCED SWITCHING THEORY.
(E.E. 684) See Electrical Engineering.

685. ADVANCED LOGIC SYSTEMS.
(E.E. 686) See Electrical Engineering.

699. RESEARCH.

CONSTRUCTION ENGINEERING

Thomas C. Jellinger, M.S., Professor in Charge

Associate Professor: Darrel D. Girton, M.S.
Assistant Professors: T.A. Gleason, M.S.; Ira J. Ward, M.S.

Undergraduate Study

For undergraduate curriculum in construction engineering leading to the degree Bachelor of Science, see College of Engineering, Curricula.

The Department of Civil Engineering provides a curriculum for those students who are interested in construction engineering. This is an area requiring specialists with a strong fundamental knowledge of engineering, plus management ability and familiarity with business, economics, and human behavior. The graduate of this program may be engaged in supervising the craftsmen and laborers on the job, ordering materials and equipment, making estimates, insuring the most rapid progress of the project, and keeping cost records. The program in construction engineering offers much of the background that contractors need. It blends engineering, management, and business administration to achieve this.

Graduate Study

The construction engineering program includes the following courses, open to graduate students for minor graduate credit only: 355, 371, 372, 441, 442, 450.

COURSES PRIMARILY FOR UNDERGRADUATE STUDENTS

100. TECHNICAL LECTURE.
(1-0) Cr: R; 8.
An examination of the nature, scope, and extent of the construction industry; an overview of the educational preparation necessary for the constructor in contemporary society.

241. ANALYSIS OF MATERIALS AND METHODS OF CONSTRUCTION.
(3-0) Cr. 3 F.W.
Prerequisite: Second year classification.
Systems of construction including wood frame, wall bearing, skeleton frame, and the materials
used in these systems. Methods and materials used in heavy construction and selection of equipment.

245. CONSTRUCTION SPECIFICATIONS.  
(3-0) Cr. 3. W.S.  
Prerequisite: 241 or Arch. 343.  
Preparation and interpretation of construction specifications and other contract documents.

246. CONSTRUCTION COST ESTIMATING.  
(2-3) Cr. 3. S.  
Prerequisite: 245.  
Estimating construction costs, quantity surveys, production rates, local cost factors. Approximate and detailed methods.

355. REAL ESTATE FINANCE.  
(I.Ad. 355) See Industrial Administration.

371. CONTRACTORS ORGANIZATION.  
(3-0) Cr. 3. F.W.  
Prerequisite: 246.  
Construction contracting business management: planning, organization, staffing, directing, controlling.

372. CONSTRUCTION PLANNING AND PROGRESS SCHEDULING I.  
(0-9) Cr. 3. W.S.  
Prerequisite: 371.  
Types of progress schedules used in construction work. Applications and advantages of types of schedules. Principles of planning construction site layouts along with methods used in field inspection.

441. CONSTRUCTION PROGRESS SCHEDULING II.  
(0-9) Cr. 3. F.  
Prerequisite: 372.  
Analysis and application of advanced scheduling techniques with emphasis on critical path method (CPM) and program evaluation and review (PERT).

442. CONSTRUCTION PROGRESS SCHEDULING III.  
(0-9) Cr. 3. W.  
Prerequisite: 441, Com.S. 301.  
A study of computer methods and applications of advanced techniques of construction scheduling with work in man-power leveling, equipment allocation, and time-cost relationships.

450. QUANTITATIVE METHODS IN CONSTRUCTION MANAGEMENT.  
(3-0) Cr. 3. S.  
Prerequisite: 442, Stat. 105.  
Analysis of construction management problems using mathematical and statistical techniques; adaptation of utility and risk functions and linear programming to construction management: decision making, statistical bidding, theory and application of bidding strategy.

490. SPECIAL PROBLEMS IN CONSTRUCTION ENGINEERING.  
Cr. 2 to 5 each time taken.  
Prerequisite: 372, permission of professor in charge of construction engineering.  
Advanced problems in construction engineering with emphasis in the field of construction operations and in the field of engineering and technology.

CROP SCIENCE

For description of courses, see Agronomy.

DAIRY SCIENCE

For description of courses, see Animal Science.

DESIGN CENTER

Advisory Council: Thomas A. Barton, M.L.A., Chairman; Martin D. Gehner, M.Arch.; Clair B. Watson, M.F.A.

The Iowa State University Design Center is an association of the Departments of Applied Art, Architecture, and Landscape Architecture. These departments offer major undergraduate and graduate programs for those students who have a serious interest in design and a dedication to the social and cultural well-being of man's environment.

The major areas of education offered by the Design Center departments are:

- Department of Applied Art
  Advertising Design
  Art Education
  General Applied Art and Crafts
  Interior Design
Courses Administered by the Design Center

*125. UNDERSTANDING THE ENVIRONMENTAL ARTS.
(3-0) Cr. 3. F.
Western culture, with selections from primitive to contemporary cities, reflecting the interrelationships of architecture, landscape architecture, urban design, painting, sculpture, and related arts.

*126. UNDERSTANDING THE ENVIRONMENTAL ARTS.
(3-0) Cr. 3. W.
The design process examined to relate the materials and methods of the artist and designer to the culture of his era.

*127. UNDERSTANDING THE ENVIRONMENTAL ARTS.
(3-0) Cr. 3. S.
Non-European culture with significant examples of the interrelationships of architecture, landscape architecture, urban design, painting, sculpture, and applied art.

490. SPECIAL PROBLEMS.
Cr. 2 to 4 each time taken.
Prerequisite: Permission of instructor.
Investigation of an approved topic commensurate with student's interest and ability.
H. Honors.

*Courses 125, 126, and 127 are offered for undergraduate students in all curricula of the University.

DISTRIBUTED STUDIES

Chalmer J. Roy, Ph.D., Dean of the College of Sciences and Humanities
  John J.L. Hinrichsen, Ph.D., Coordinator
  Frank E. Bortle, Ph.D., Coordinator
  Charles C. Bowen, Ph.D., Assistant Dean
  Millard R. Kratochvil, M.A., Assistant Dean
  Alston J. Shakeshaft, M.S., Assistant to Dean
  Richard Zbaracki, Ph.D., Chairman, Teacher Education Committee,
  College of Sciences and Humanities

Oscar E. Tauber, Ph.D., Chairman, Committee for Graduate Programs in General Science

Professors: John A. Bath, Ph.D.; Delma Harding, Ph.D.; Millard R. Kratochvil, M.A.; Duncan Mallam, Ph.D.; Harry J. Schmidt, M.A.

Associate Professors: Leo R. Schneider, M.S.; Arthur G. Swift, M.M.


Instructors: Leslie A. Anderson, M.S.; Elizabeth E. Buckels, M.S.; James E. Dixon, B.A.

Undergraduate Study

Opportunities for broadly based studies in the sciences and humanities are provided by programs in distributed studies. In general these programs are less specialized than others in this college but insure significant depth as well as breadth. Programs in distributed studies are appropriate preparation for professional studies in veterinary medicine, medicine, law, and specialized technologies. Preprofessional students should consider the desirability of a program which combines three years of preprofessional and the first year of professional study to meet the requirements for either the Bachelor of Arts or the Bachelor of Science degree. Programs leading to the two degrees are flexible and will vary in accordance with the educational objectives of the student. (See Preprofessional Programs.) Programs in distributed studies
are also appropriate as preparation for teaching in secondary schools (see College of Education), and as preparation for graduate studies in certain interdisciplinary areas.

Graduate Study

Open to graduate students for minor credit: 480.

**COURSES PRIMARILY FOR UNDERGRADUATE STUDENTS**

101, 102, 103. STUDIES IN SCIENCES AND HUMANITIES.*
Cr. 1 to 5 each time taken. Yr.
Prerequisite: Permission of instructor.
Experimental or honors courses offered by any department or interdepartmental group.

201, 202, 203. INTRODUCTION TO LATIN AMERICA.
(3-0) Cr. 3 each. Yr.
Prerequisite: 202; 201; 203; 201 or 202.
201: Continent, peoples, and cultures.
202: History and cultural heritage.
203: Contemporary social, economic, and political problems.

204, 205, 206. INTRODUCTION TO AFRICA.
(3-0) Cr. 3 each. Yr.
Prerequisite: 205; 204 or 205.
204: Continent, peoples, and cultures.
205: History and cultural heritage.
206: Contemporary social, economic, and political problems.

207, 208, 209. INTRODUCTION TO EAST ASIA.
(3-0) Cr. 3 each. Yr.
Prerequisite: 208; 207; 209; 207 or 208.
207: Continent, peoples, and cultures.
208: History and cultural heritage.
209: Contemporary social, economic, and political problems.

301, 302, 303. STUDIES IN SCIENCES AND HUMANITIES.*
Cr. 1 to 5 each time taken. Yr.
Prerequisite: Junior standing and permission of instructor.
Experimental or honors courses offered by any department or interdepartmental group.

417. STUDENT TEACHING.
Cr. 2 to 12 each time taken. F.W.S.
Prerequisite: Educ. 305; Eng. 494 or Sp. 495 or Math. 497 or D.St. 486 or 496 or P.E.M. 497 or F.L. 476 or Music 468; advance reservation required.
Observation, evaluation,struction, lesson planning, and teaching in the sciences and humanities.
A. Social Studies.
B. Physical Sciences.

480. SPECIAL PREPARATION IN SUBJECT MATTER FOR ELEMENTARY AND SECONDARY TEACHERS.
Cr. var. Maximum of 12 credits in each area listed below:
A. Social Studies.
B. Physical Sciences.
C. Mathematics.
D. Biological Sciences.
E. English and Literature.
F. Physical Education for Men.
G. Foreign Languages.
H. Speech.
I. Journalism.
J. Earth Science.
K. Music—Secondary.
L. Music—Elementary.

**EARTH SCIENCE**

Keith M. Hussey, Ph.D., Head of Department

Professors: Donald L. Biggs, Ph.D.; Charles S. Gwynne, Ph.D.; John Lemish, Ph.D.; Chalmer J. Roy, Ph.D.

Associate Professors: Robert C. Palmquist, Ph.D.; Mushtaq-ur Rahman, Ph.D.; Karl E. Selfert, Ph.D.; Lyle V.A. Sendlein, Ph.D.; Carl F. Vondra, Ph.D.

Assistant Professors: W. Gale Biggs, Ph.D.; Robert D. Cody, Ph.D.; Harry C. Vaughan, M.S.; Douglas N. Yarger, Ph.D.

Instructors: Sidney O. Barnard, M.S.; Gary D. Johnson, M.S.; Jimmie L. Richardson, M.S.; David E. Simon, M.S.; Jane T. Zaring, M.A.
Undergraduate Study

For undergraduate curriculum in sciences and humanities leading to the degree Bachelor of Science, majors in earth science, geology, and meteorology, see Sciences and Humanities, Curriculum.

The department offers courses in geography, geology, and meteorology. In addition, a specialized program in climatology is offered in the Department of Agronomy.

Courses in geology and meteorology may be used to fulfill Group 3 requirements in the College of Sciences and Humanities; geography courses may be used in Group 5. The following programs are recommended to students concentrating in the various fields of study in earth science:

Students majoring in earth science will take a minimum of 30 hours in the department, 15 hours at the 300 level and above. Course work must be taken in all three disciplines (geography, geology, and meteorology) offered by the department. Students wishing to obtain a teaching certificate must satisfy the requirement of the College of Education. (See College of Education.)

Students majoring in geology generally complete the following courses: Geol. 100, 204, 271, 302, 351, 361, 371, 381, 431, 440, and 492. Minor work is recommended in mathematics and in one of the following fields: chemistry, civil engineering, computer science, physics, statistics, or zoology.

Students specializing in geophysics commonly take the following courses: Geol. 271, 302, 340, 351, 371, 381, 431, 440, and 492. Minor work is recommended in computer science, mathematics or physics.

To major in meteorology students normally take the following courses: Mteor. 206, 301, 302, 406, 441, 442, 443, 455, 456. Minor work is recommended in computer science, engineering mechanics, mathematics, or physics. The meteorology program is closely related to the climatology program. For further information concerning climatology, see Agronomy.

The above lists of courses are not to be regarded as statements of fixed requirements or as complete outlines of the work necessary for graduation. They are given solely for the convenience of students or advisers.

Graduate Study

The department offers work for the degrees Master of Science and Doctor of Philosophy with majors in earth science, geology, and meteorology, and minor work to students majoring in other departments. A nonthesis option is offered for the degree Master of Science in earth science and in meteorology. Geology majors interested in a broader program may obtain the degree Doctor of Philosophy with a major divided between geology and a related field. The department also cooperates in an interdepartmental program leading to the degrees Master of Science and Doctor of Philosophy in water resources with major work in geology and subordinate work in other fields. See Water Resources.

Students desiring to major in earth science, geology, meteorology, or water resources should have mathematics through calculus and one year each of college physics and college chemistry in addition to some background in earth science.

The department requires no foreign language proficiency for the M.S. degree. Candidates for the Ph.D. degree are required to submit proof of reading knowledge of two foreign languages or reading and speaking knowledge of one. The candidate's graduate committee may accept, as proof of mastery, either course grades in language courses taken at Iowa State University or examination scores of comprehensive examinations administered by the Foreign Language Department.

Course programs are arranged on an individual basis. Minor work is normally recommended in chemistry, computer science, engineering mechanics, mathematics, metallurgy, physics, soils, soils engineering, or zoology.

The following courses are open to graduate students for minor graduate credit only: Geog. 322, 324, 325, 421, 490; Geol. 302, 340, 351, 361, 371, 381, 400, 401, 402, 407, 411, 431, 440, 452, 490, 492; Mteor. 406, 421, 441, 442, 443, 455, 456, and 490.
COURSES PRIMARILY FOR UNDERGRADUATE STUDENTS

Geography

201. WORLD GEOGRAPHY. (3-0) Cr. 3. F.
Character and distribution of the elements comprising man's physical environment; inter-relationships of the man-environment system.

322. ECONOMIC GEOGRAPHY. (3-0) Cr. 3. Alt. W, offered 1973.
Character and distribution of natural resources; their influence on man and their utilization by man.

324. CULTURAL GEOGRAPHY—EUROPEAN AND AMERICAN. (3-0) Cr. 3. W.
Climate and physical geography of Europe and North, Central, and South America, and their influence on the cultural development of man in those areas.

Geology

100. INTRODUCTION TO GEOLOGY. (3-3) Cr. 4. F.W.S.S.
Important earth processes, materials, and their interaction. Field trips.

101. TECHNICAL LECTURES. (1-0) Cr. R; F.
Introduction to various phases of earth science. Required of all beginning students majoring in the earth sciences.

200. GEOLOGICAL ASPECTS OF ENVIRONMENT. (3-3) Cr. 4. F.
Prerequisite: 100.
Physical processes and forms and their relationship to man. Discussion of surface and near-surface geologic processes, mineral occurrence, and their use and misuse by man.

201. HISTORY OF THE EARTH. (3-3) Cr. 4. W.
Prerequisite: 100.
Significant events in the geologic history and development of life upon the earth.

203. GEOLOGY FIELD TRIP. Cr. 1 each time taken. W.S.
Prerequisite: 100, permission of instructor.
Geology of selected regions studied by correlated readings and report presentation followed by a field trip to points of geologic interest.

204. MAP INTERPRETATION. (0-3) Cr. 1. S.S.S.
Prerequisite: 100.
Analysis of topographic and geologic maps.

230. PHYSIOGRAPHY OF THE UNITED STATES. (3-0) Cr. 3. S.
Prerequisite: 100.
Description and interpretation of the physical features in the natural regions of the United States, and man's adaptations to the physical environment.

271. EARTH MATERIALS. (2-6) Cr. 4. S.
Prerequisite: 100.
Field and laboratory identification, classification, description, and interpretation of rocks, fossils, and common rock-forming minerals.

301. GEOLGY FOR ENGINEERS. (2-3) Cr. 3. S. Sendlelm.
Fundamentals of geology and engineering applications. Field trips.

325. CULTURAL GEOGRAPHY—AFRICAN, ASIAN, AUSTRALIAN, AND PACIFIC ISLANDS. (3-0) Cr. 3. S.
Climate and physical geography of Africa, Asia, Australia, and the Pacific Islands; their influence on the cultural development of man in those areas.

421. SETTLEMENT GEOGRAPHY. (3-0) Cr. 3. Alt. W, offered 1972.
Prerequisite: 201.
Evolution, morphology, and spatial distribution of urban and rural settlement with an emphasis on North America and Europe.

490. SPECIAL PROBLEMS. Cr. 2 to 4 each time taken.
Prerequisite: 201, permission of instructor.
400. ADVANCED FIELD GEOLOGY.
   Cr. 8 to 12. SS.
   Prerequisite: 371, 381. Vondra.
   An eight-week field course for the advanced
   geology major, emphasizing advanced field tech­
niques and providing the student with experience
in analyzing geologic field problems.

401. GEOLOGY OF EASTERN NORTH AMERICA.
   (3-0) Cr. 3. Alt. W, offered 1972.
   Prerequisite: 371, 381. Selbst.
   Coastal Plains, Appalachians, West Indies, Cen­
tral Interior, and Canadian Shield.

402. GEOLOGY OF WESTERN NORTH AMERICA.
   (3-0) Cr. 3. Alt. W, offered 1973.
   Prerequisite: 371, 381. Selbst.
   Rockies, Basin and Range, Sierra Nevadas, Cas­
cades, and Coast Ranges.

407. GEOLOGIC INTERPRETATION OF
   AERIAL PHOTOGRAPHS.
   (1-6) Cr. 3. Alt. F, offered 1971.
   Prerequisite: 100. Palmquist.
   Principles of aerial photography and imagery
   used in qualitative and quantitative analysis of
   geologic features from aerial photographs.

411. PRINCIPLES OF ECONOMIC GEOLOGY.
   (3-3) Cr. 4. F.
   Prerequisite: 371, 381. Lemish.
   Nature and origin of mineral deposits.

431. GEOMORPHOLOGY.
   (3-3) Cr. 4. F.
   Prerequisite: 100, Stat. 101. Palmquist.
   Interrelationship between geomorphic processes
   and earth materials in development of land­
   forms; use of landforms in interpretation of re­
cent geologic history. Saturday field trips.

440. PETROPHYSICS.
   (2-6) Cr. 4. W.
   Prerequisite: 302, 371, 381, Math. 213, Phys.
   223, Sendleir.
   Physical properties of rocks, including porosity,
   permeability, elastic properties, and heat and
   electrical conductivity. Rocks studied through
   laboratory investigations to establish their rela­
tionship to natural geologic materials and pro­
cesses.

452. OPTICAL MINERALOGY.
   (2-6) Cr. 4. W.
   Prerequisite: 351. D.L. Biggs.
   Relationships of structure, symmetry, and optical
   properties of transparent crystals. Study of prin­
cipal rock-forming minerals with polarizing mi­
croscope.

455, 466. INTRODUCTION TO HYDROSACE
   ENGINEERING.
   (Aer.E. 455, 466) See Aerospace Engineering.

490. SPECIAL PROBLEMS.
   Cr. 2 to 4 each time taken.
   Prerequisite: 100, permission of instructor.
   H. Honors Program.

492. STRATIGRAPHY.
   (3-3) Cr. 4. F.
   Prerequisite: 361, 371, 381. Vondra.
   Principles of stratigraphy and their application
   to and exemplification by geologic occurrences.

COURSES PRIMARILY FOR GRADUATE STUDENTS, major or minor, open to
qualified undergraduates

Geology

501. SEMINAR.
   Cr. 1 each time taken. F.W.S.
   Prerequisite: Permission of Instructor.

512. ADVANCED ECONOMIC GEOLOGY.
   Prerequisite: 411. Lemish.
   Geology applied to mining; significant deposits
   and districts.

515. GEOCHEMISTRY.
   (3-6) Cr. 5. Alt. F, offered 1971.
   Prerequisite: Chem. 211, 301; permission of In­
   structor. Lemish.
   Emphasis on chemistry of geological processes
   related to changes in earth materials.

521. SEDIMENTATION.
   (3-4) Cr. 5. Alt. W, offered 1972.
   Prerequisite: 412, 415, Cody.
   Survey of sedimentation processes with emphasis
   on clastic sedimentation.

531. QUATERNARY GEOLOGY.
   Prerequisite: 431. Palmquist.
   Use and interpretation of variations in char­
   acter of landforms, sediments, and fossils in
   reconstruction of Quaternary events and environ­
   ments. Saturday and weekend field trips.

532. DYNAMICS OF GEOMORPHIC SYSTEMS.
   Prerequisite: 431. Palmquist.
   Analysis of geomorphic systems acting under
   various constraints and of the resulting land­
   forms.

535. GROUNDWATER GEOLOGY.
   Prerequisite: 440, C.E. 304. Sendleir.
   Occurrence and distribution of subsurface wa­
er; nature of conducting media.

551. ADVANCED MINERALOGY.
   Prerequisite: 452. D.L. Biggs.
   Structural, chemical, and paragenetic relations­
   ships of common rock-forming minerals.

561. VERTEBRATE PALEONTOLOGY.
   Prerequisite: 361, Zool. 320. Vondra.
   Morphology (cranial, dental, and post-cranial),
   taxonomy, evolution, and distribution of fossil
   vertebrates with emphasis on mammals.

565. ADVANCED INVERTEBRATE
   PALEONTOLOGY.
   Prerequisite: 361. Cody, Vondra.
   Selected topics in paleontology and paleoeco­
   logy; sedimentary environments and their ef­
   fects on organisms, stratigraphic correlation,
   interpretation of earth history, advanced mor­
   phologic descriptions of fossils.

571. IGNEOUS PETROLOGY.
   Prerequisite: 371, Math. 213. Selbstert.
   Review of igneous petrology; discussion of field
   observations and laboratory data. Emphasis on
   approach to equilibrium. Study of selected ign­
   eous rocks.

575. METAMORPHIC PETROLOGY.
   Prerequisite: 371, Math. 213. Selbstert.
   Review of metamorphic petrology with discussion
   of field observations and laboratory data. Em­
   phasis on approach to equilibrium. Study of
   selected metamorphic rocks.
Prerequisite: 581. Lemish.  
Current theories of rock deformation and advanced problems in metamorphic, igneous and sedimentary structures.

590. SPECIAL TOPICS.  
Cr. 1 to 3 each time taken.  
A. Geomorphology.  
B. Stratigraphy.  
C. Paleontology.  
D. Petrology and Mineralogy.  
E. Structural Geology.  
F. Geochemistry.

592. ADVANCED STRATIGRAPHY.  
(3-2) Cr. 4. Alt. F., offered 1972.  
Prerequisite: 492, 521. Vondra.  
Interpretation of sedimentary rocks and rock bodies to infer processes, environments, and tectonic settings under which they formed. Major facies of Cenozoic deposits of selected regions studied and analyzed.

COURSES FOR GRADUATE STUDENTS, major or minor

Geology

651. CLAY MINERALOGY.  
Prerequisite: 551, Chem. 325. D.L. Biggs.  
Geological significance, structure, and chemistry of clay minerals.

672. ADVANCED SEDIMENTARY PETROLOGY.  
Prerequisite: 571. D.L. Biggs.  
Advanced study of petrology and petrography of sedimentary rocks. Field trips.

675. ROCK DEFORMATION.  
Prerequisite: 581, Math. 213. Seifert.  
Theory and experimental conditions for rock deformation; stress-strain relations. Deformation of selected rocks.

678. DEFORMATION OF MINERALS.  
Prerequisite: 571, Math. 213. Seifert.  
Analysis of deformation in rock-forming minerals; interpretation in terms of petrogenesis; plastic flow at elevated temperatures and pressures. Universal stage identification of deformation mechanisms.

685. GEOTECTONICS.  
(3-0) Cr. 3. Alt. W, offered 1972.  
Prerequisite: 441, 442, 492, Hussey, Roy.  
Distribution and dynamic history of sedimentary basins and mountain ranges of the world.

698. RESEARCH.  
Cr. 1 to 3 each time taken.  
A. Geomorphology.  
B. Stratigraphy.  
C. Paleontology.  
D. Petrology and Mineralogy.  
E. Structural Geology.  
F. Geochemistry.  
G. Water Resources.  
H. Earth Science.  
I. Sedimentation.  
J. Economic Geology.  
K. Rock Deformation.  
L. Geophysics.

COURSES PRIMARILY FOR UNDERGRADUATE STUDENTS

Meteorology

206. INTRODUCTION TO METEOROLOGY.  
(Agron. 206) See Agronomy.

208. TECHNIQUES OF WEATHER OBSERVATION.  
(2-0) Cr. 2. S.  
Use of standard meteorological instruments, hydrometers, pilot balloon; cloud coding. Experience in collecting and coding meteorological data at a first-order weather station.

301, 302. GENERAL METEOROLOGY I, II.  
301: (3-0) Cr. 3. F.; 302: (2-0) Cr. 4. W.  
Prerequisite: 501: 206, Math. 110; 302: 301.  
Basic physical concepts which influence our earth and its atmosphere. Concepts of weathermap analysis.

311. AVIATION METEOROLOGY.  
(2-0) Cr. 2. F. Vaughan.  
Application of meteorology to aviation.

406. CLIMATES OF THE CONTINENTS.  
(Agron. 406) See Agronomy.

421. METEOROLOGICAL INSTRUMENTS.  
(2-3) Cr. 3. W. Vaughan.  
Prerequisite: Three credits of meteorology, Math. 112; Phys. 112 or 223.  
Theory and techniques of conventional meteorological instruments. Limitations of specific instruments and systems encountered in field and laboratory measurements. Emphasis on theory and calibration of instruments.

441, 442, 443. INTRODUCTION TO THEORETICAL METEOROLOGY I, II, III.  
(4-0) Cr. 4 each. Yr. Yarger.  
Prerequisite: 441: Phys. 112 or 223; Math. 112; 442: 441; 443: 442.  

455, 456. SYNOPTIC METEOROLOGY I, II.  
(1-6) Cr. 3 each. 455: W; 456: S.  
Prerequisite: 455: 302; 456: 455. Barnard.  
Construction of meteorological charts for forecasting weather elements; kinematic analysis, air mass analysis, fronts and pressure systems, graphical determination of thickness patterns, interpretation of centrally prepared weather charts.

490. SPECIAL PROBLEMS.  
Cr. var.  
Prerequisite: Permission of Instructor.
COURSES PRIMARILY FOR GRADUATE STUDENTS, major or minor, open to qualified undergraduates

Meteorology

505. MICROCLIMATOLOGY.
   (Agron. 505) See Agronomy.

506. METHODS IN CLIMATOLOGY.
   (Agron. 506) See Agronomy.

521. ADVANCED INSTRUMENTATION.
   Prerequisite: Three credits of meteorology, Math. 213, Phys. 223. Vaughan.
   Theoretical treatment of meteorological instruments and systems with particular emphasis on research instruments for micrometeorological measurements. Survey of transducers available, their responses and limitations.

542. PHYSICAL METEOROLOGY.
   (3-0) Cr. 3. F.
   Prerequisite: Phys. 223, Math. 213. Yarger.
   Wave phenomena, propagation of energy through the atmosphere, atmospheric optics, visibility, scattering phenomena, the upper atmosphere.

543, 544. DYNAMIC METEOROLOGY I, II.
   (4-0) Cr. 4 each. 543: W; 544: S.

571, 572. CLOUD PHYSICS I, II.
   Prerequisite: 443. Yarger.
   571: Cloud dynamics, thermodynamics of phase-change and nucleation, numerical techniques in cloud physics, condensation nuclei and ice nuclei, diffusional growth of cloud drops and ice crystals. 572: Ice crystals and coalescence theories of initiation of precipitation, aerodynamic theory, accretional growth of raindrops and ice particles, cloud modification techniques.

590. SPECIAL TOPICS.
   Cr. var.
   Prerequisite: Permission of Instructor.

COURSES FOR GRADUATE STUDENTS, major or minor

Meteorology

605. MICROMETEOROLOGY.
   (5-0) Cr. 5. Alt. F. offered 1971.
   Prerequisite: 505; 442 or E.M. 378. W.G. Biggs.
   Physical processes in the atmosphere near the ground; laminar and turbulent flow; transfer of heat, mass, and momentum; eddy diffusion; statistical theories of turbulence; wind and temperature profiles near the surface; evaporation.

610. ATMOSPHERIC TURBULENCE AND DIFFUSION.
   (4-0) Cr. 4. Alt. F. offered 1971.
   Prerequisite: 605. W.G. Biggs.

641, 642. ATMOSPHERIC RADIATION.
   Solar and terrestrial radiation, radiative transfer equation, atmospheric radiation charts, Stokes parameters, polarization.

699. RESEARCH.
   Cr. var.
   Prerequisite: Permission of instructor.
ECONOMICS

Karl A. Fox, Ph.D. Head of Department


Assistant Professors: Russell G. Pounds, M.S.; Ronald Raikes, Ph.D.; Robert N. Wisner, Ph.D.


Undergraduate Study

The department offers work for the degree Bachelor of Science with a major in agricultural business and for the degrees Bachelor of Science and Bachelor of Arts with a major in economics. For further discussion of programs in agricultural business, see the statement under College of Agriculture, and for programs in economics, see the statement under College of Sciences and Humanities.

College of Agriculture

For the undergraduate curriculum in agricultural business, see College of Agriculture, Curricula.

Students majoring in agricultural business must select one minor from economic analysis, farm management, marketing management, public policy, agricultural education, and agricultural communication. A second minor may be developed in related departmental areas. The curriculum prepares students for advanced studies and for careers in farm and ranch operations, commercial farm management and appraisal, agricultural finance, agricultural supply and marketing industries, research for business firms, agricultural reporting and public relations, agricultural extension, and government service.

College of Sciences and Humanities

Candidates for either the Bachelor of Science or the Bachelor of Arts degree must satisfy the requirements established by the College of Sciences and Humanities. (For undergraduate curricula in sciences and humanities, see College of Sciences and Humanities, Curriculum.) Departmental requirements may be satisfied in meeting the general education requirements of the College of Sciences and Humanities or in meeting minor, elective, or in some cases, double major requirements.

For the degree Bachelor of Science, the department requires the following: Engl. 414; a minimum of 21 credits of mathematical sciences, including Math. 110, Stat. 101, and Com.S. 201; a minimum of 12 credits in at least two of the following: anthropology, geography, industrial administration, political science, psychology, and sociology; a minimum of 12 credits of humanities; and 30 credits of economics above the 200 level, including 307, 308, and 409.

For the degree Bachelor of Arts, the department requires the following: Engl. 414; a minimum of 15 credits of mathematical sciences, including Stat. 101; a minimum of 18 credits in at least two of the following: anthropology, geography, political science, psychology, and sociology; a minimum of 18 credits in humanities; and 30 credits of economics above the 200 level, including 307, 308, 312, and 409.

A variety of programs can be developed within the economics major, depending on the interests and career goals of the individual student. All of these programs are based on the required sequence for either the degree Bachelor of Science or Bachelor of Arts with additional courses chosen to support the student's objectives. Among the programs are economic theory (pregraduate school program), quantitative economic analysis, industrial economics, international trade and development, labor and manpower economics, urban and regional economics, and prelaw.

Graduate Study

The department offers work for the degrees Master of Science and Doctor of Philosophy with majors in economics and agricultural economics, and minor work to students taking major work in other departments.

Candidates for the degree Master of Science are required to complete satisfactorily 45 credits of acceptable graduate work including preparation of a thesis.

With the approval of the program of study committee, candidates for the degree Master of Science may fulfill requirements by completing satisfactorily 54 credits of course work, in which case preparation of a thesis is not required.

Prerequisite to major work in the department is the completion of undergraduate work in economics, mathematics, statistics, and other social science and technical subjects substantially equivalent to that required of undergraduate students majoring in economics or agricultural business.

There is no foreign language requirement for the degree Master of Science.

Programs of study for Ph.D. degrees are organized by each student in consultation with his major professor and his individual committee. Students may select fields of concentration from the following:

- Advanced Economic Theory
- Agricultural Marketing and Price Analysis
- Agricultural Development, Trade, and Policy
- Agricultural Finance and Land Valuation
- Econometrics
- Economic Planning and Development
- Industrial Organization
- International Economics
- Labor Economics
- Monetary Economics
- Operations Research
- Production Economics and Farm Management
- Public Finance and Fiscal Policy
- Regional-Urban Economics
- Resource Economics and Area Development

Each student is expected to achieve a minimum competence in economic theory as demonstrated by completing basic and advanced courses in microeconomic and macroeconomic theory and by completing a preliminary written examination. Examinations are also required in two other fields selected from the list above. An outside minor, such as statistics, mathematics, or computer science, can be substituted for one of the fields.

The language requirements for the Ph.D. degree may be satisfied by one language at a
high level of competence, by two languages at a lower level, or by substitution of additional coursework outside of the major, minor, and primary supporting fields.

Cooperative programs of study may be arranged with the University of Iowa College of Law or with other recognized institutions.

The department is a cooperative department in the Industrial relations program. See Industrial Relations.


COURSES PRIMARILY FOR UNDERGRADUATE STUDENTS

*110. ORIENTATION IN AGRICULTURAL BUSINESS.
   (1-0) Cr. R: F.
   Field of agricultural economics.

*121. AGRICULTURAL ECONOMICS.
   (3-0) Cr. 3. F.S.
   Role of agriculture in the American economy. Introduction to the economics of agricultural production and marketing.

*130. ELEMENTS OF FARM MANAGEMENT.
   (3-2) Cr. 4. F.W.S.
   Application of economic principles to organization and management of a farm. Budgeting, size of business, choice of enterprise; timing of production, farm labor utilization, farm layouts; leases and farm credit. A student cannot count credit for both 130 and 330 toward a degree.

*190. SUPERVISED PRACTICE.
   Cr. 1 to 12. F.S.S.
   Prerequisite: Nine credits in economics.
   Twelve to 24 weeks of full-time observation and supervised experience in the employ of selected agricultural businesses. Not more than six credits will apply toward a B.S. degree.

*230. FARM ACCOUNTING AND BUSINESS ANALYSIS.
   (2-2) Cr. 3. F.W.S.
   Purpose and methods of keeping farm records and procedures in accounting; income and net worth statements; use of efficiency factors; analysis of the farm business; and the use of accounts for tax purposes.

241. PRINCIPLES OF ECONOMICS.
   (3-0) Cr. 3 each. F.W.S. SS.

243. CONTEMPORARY ECONOMIC PROBLEMS AND POLICIES.
   (3-0) Cr. 3. F.W.S.
   Prerequisite: 241, 242.
   Topics depend upon current socio-economic issues, such as economic growth and development, poverty, urban economic problems, inflation, balance-of-payments problems.

*292. MARKETING BUSINESS OPERATIONS.
   (3-2) Cr. 4. F.S.
   Prerequisite: Six credits in economics.
   Application of accounting and business management to the operation of agricultural marketing and purchasing plants. Use of plant records, forms, and statements; merchandising; employee supervision; and production plan. Visits to representative businesses.

305. LABOR ECONOMICS AND LABOR RELATIONS.
   (3-0) Cr. 3. F.W.S. SSII.
   Prerequisite: 242.

306. COMPARATIVE ECONOMIC SYSTEMS.
   (3-0) Cr. 3. F.W.S.
   Prerequisite: 242.
   Comparison of alternative forms of economic organization, particularly capitalism, liberal socialism, and central planning; emphasis on selected problems associated with respective economic systems; prospects for institutional change.

307, 308. PRICES AND RESOURCE ALLOCATION.
   (3-0) Cr. 3 each. 307: F.W.S. SS; 308: W.S. SSII.
   Theory of consumption and of the business firm; competitive and monopolistic markets; distribution of income; general equilibrium of the pricing system.

312. HISTORY OF ECONOMIC THOUGHT.
   (3-0) Cr. 3. S.
   Prerequisite: 242.
   History of economic thought as related to the intellectual history of the times. Major persons treated include Smith, Ricardo, Marx, Marshall, and Keynes.

314, 315. MONEY AND BANKING.
   (3-0) Cr. 3 each. 314: F.W.S. SS; 315: W.S. SSII.
   Prerequisite: 314: 242; 315: 314.
   314: History and theory of banking; market structure of commercial banking; bank management; money and capital markets; determination of the money supply; factors affecting bank reserves. 315: History of central banking; structure of the Federal Reserve System; monetary theory; domestic monetary policy; international finance and policy; recent monetary policy.

*330. FARM MANAGEMENT AND ORGANIZATION.
   (3-2) Cr. 4. F.W.S. SS.
   Prerequisite: 242; 230 or I. Ad. 384 recommended.
   Organization and management of a farm with emphasis on use of economic principles. Enterprise selection, size of business, budgeting, leases, layout, and farm analysis. A student cannot count credit for both 130 and 330 toward a degree.

*336. AGRICULTURAL MARKETING.
   (3-0) Cr. 3. F.W.S. SS.
   Prerequisite: 242.
   Study of the price-making forces for agricultural products; improving the accuracy of the system that reflects consumers' demand to producers; effect of monopolistic elements on efficiency; reducing the costs and increasing the efficiency of marketing.
*336. AGRICULTURAL MARKETING LABORATORY.
(0-4) Cr. 2. F.
Prerequisite: Credit or classification in 335.
Estimating prospective demand and supply for farm products; interpretation of government reports and the preparation of outlook information; analysis of the futures market and the role of speculators; methods for livestock and grain producers and other marketing agencies.

*403. MARKETING LIVESTOCK AND MEAT.
(3-0) Cr. 3. B.
Prerequisite: 242.
The demand, supply, and distribution of livestock and meat. Analysis of changes in marketing methods; grades, values, prices, and costs. Visits to marketing agencies and firms.

405. PUBLIC FINANCE.
(3-0) Cr. 3. F.W.B.
Prerequisite: 242.
Principles of taxation; federal, state, and local revenue and expenditure policies; current issues in public finance.

409. NATIONAL INCOME AND EMPLOYMENT.
(3-0) Cr. 3. F.W.S.S.SI.
Prerequisite: 335.
National income accounting. Static and dynamic theories of the determination of national income and employment and of business fluctuations. Monetary and fiscal policies for promoting economic stability and growth.

410. INDUSTRIAL STRUCTURES AND COMPETITION.
(3-0) Cr. 3. B.
Prerequisite: 308.

411. ECONOMICS OF UNDERDEVELOPED NATIONS.
(3-0) Cr. 3. F.
Prerequisite: 242.
Analysis of capital formation and capital allocation problems; relation of transportation, communications, and resource availability to development; population and education problems as they relate to growth.

*412. ECONOMICS OF AGRICULTURAL DEVELOPMENT.
(3-0) Cr. 3. W.
Prerequisite: 242; 330 or 436.
Less-developed economies; share and role of agriculture in labor and national income; structure of agriculture; subsistence and commercial sectors; population, food, and nutrition; institutional considerations; policies for development; aid and international trade.

*421. AGRICULTURAL COOPERATION.
(3-0) Cr. 3. W.
Prerequisite: 242.
General survey of cooperative activities, with special reference to agriculture; kinds of cooperatives, methods of organization and operation; principles, legal requirements; economic possibilities and limitations of cooperation.

*430. ADVANCED FARM ORGANIZATION AND MANAGEMENT.
(2-2) Cr. 3. F.W.S.
Prerequisite: 242; 130 or 330.
Applications of budgeting and linear programming to planning organizations for varying soil, market, capital, tenure, and farm-size situations.

*432. MANAGEMENT OF TENANT-OPERATED FARMS.
(3-0) Cr. 2. W.
Prerequisite: Senior classification; 130 or 330.
Business techniques; application of economic principles to the operation of rented farms; working relationships with farm tenants. Two all-day field trips.

*434. NATURAL RESOURCE MARKETING ANALYSIS.
(3-0) Cr. 3. F.
Prerequisite: 242.
Natural resources, including soil, water, forests, minerals, air, and location, in the production process. Natural resources and population interrelationships. Types and intensities of uses, including urban, recreational, agricultural, industrial, and transportation. Private and public interests, ownership, tenancy, and transfers. Use and tenure policies. Conservation.

*435. AGRICULTURAL FINANCE.
(3-0) Cr. 3. W.
Prerequisite: 242.
Financial requirements of individuals and principles applicable to borrowing by farms and farm cooperative organizations. Analysis of lending agencies including commercial banks, insurance companies, merchants and dealers, Farm Credit Banks, and Farmers Home Administration.

*436. AGRICULTURAL MARKETING.
(3-0) Cr. 3. W.
Prerequisite: 242.
Analysis of demands, costs, and efficiency in agricultural marketing, processing, and farm-supply organizations. Analysis of the pricing processes as related to agricultural commodities. Effects of industry organization and government programs.

*440. APPRAISAL OF FARM REAL ESTATE.
(2-3) Cr. 3. S.
Prerequisite: 242, Agron. 154.
Land appraisal with emphasis on valuation procedure. Relationship of farm prices, taxes, and interest rates to value. Appraisal reports.

441. MANPOWER ECONOMICS.
(3-0) Cr. 3. W.
Prerequisite: 305.
Wage theories and processes of wage determination; economic and institutional forces determining the level and composition of labor supply and demand; manpower implications of automation; labor mobility; governmental manpower policies.

444. MANAGEMENT: THEORY AND PRACTICE.
(3-0) Cr. 3. F.W.S.
Prerequisite: 307; Math. 110 recommended.
An analytical approach to business management. Business decision making with the aid of organization theory, linear programming, statistical techniques, and other elements of operations research.

445. COLLECTIVE BARGAINING.
(3-0) Cr. 3. F.
Prerequisite: 305.

*447. INTRODUCTION TO AGRICULTURAL POLICY.
(3-0) Cr. 3. F.W. Alt. 891, offered 1973.
Prerequisite: 242.
Introductory analysis of efficiency and income problems in American agriculture; description and appraisal of price-support programs, conservation programs, and programs to aid low-income families.
451. AGRICULTURAL LAW.
(3-0) Cr. 3. W.
Prerequisite: Senior classification.
The legal framework impinging upon decision making by farm firms, families, and individuals: liabilities, real and personal property, contracts, uniform commercial code, organization of farm firms, inter-generation property transfers, water law, fence law, federal and state regulatory powers, and insurance.

452. AGRICULTURAL TAXATION.
(3-0) Cr. 3. S.
Prerequisite: 451.
Income tax management, real and personal property taxes, estate and inheritance taxes, excise taxes, sales and use taxes imposed upon the farm family and firm. Emphasis on use of available source materials.

455. INTERNATIONAL ECONOMICS.
(3-0) Cr. 3. F.W.S.SI.
Prerequisite: 242.
Principles of international trade, exchange rates, and balance of payments adjustments. Commercial and foreign investment policies. Foreign trade and American agriculture and industry.

456. INTERNATIONAL FINANCE.
(3-0) Cr. 3. W.
Prerequisite: 455.
Methods of financing international trade. The foreign exchange and the gold standard. International financial institutions, short- and long-term capital movements, and problems of international liquidity.

461, 462. URBAN-REGIONAL ECONOMICS.
(3-0) Cr. 3 each. 461: S; 462: F.
Prerequisite: 242.

COURSES PRIMARILY FOR GRADUATE STUDENTS, major or minor, open to qualified undergraduates

501, 502. INTERMEDIATE MICROECONOMIC ANALYSIS.
(3-0) Cr. 3 each. 501: F.W.S.SI; 502: W.S.S.SII.
Prerequisite: 308. Fletcher, Staff.
Economic theory and methodology; theory of consumer behavior and demand; production functions, costs, and firm behavior; equilibrium of consumers, firms, and industries; general equilibrium, economic efficiency and welfare; behavior of firms in nonperfect competition and optimality of resource allocation; functional income distribution and the behavior of income shares.

503. INTERMEDIATE MACROECONOMIC ANALYSIS.
(3-0) Cr. 3. F.S.SSI.
Prerequisite: 409. Brady, Starleaf.
Determination of the level of national income and employment; measurement, analysis, and control of aggregate economic activity. Examination of the postulates and policy implications of the classical, neoclassical, Keynesian, and neo-Keynesian models.

504, 505. QUANTITATIVE METHODS IN ECONOMIC ANALYSIS.
(0-3) Cr. 1 each. 504: F; 505: W.
Prerequisite: Graduate standing and permission of instructor.
Selected applications of mathematical and other quantitative techniques in economic analysis; economic application of selected concepts in finite mathematics, calculus, difference-differential equations, and elementary matrices.

510. NATURAL RESOURCE USE AND CONSERVATION.
(3-0) Cr. 3. W.S.S.
Prerequisite: 308 or 434. Harl, Thomas, Timmons.
Natural resource classes and economic limits of investment and disinvestment in water, soil, forests, minerals, and air. Cost benefit analysis. Meaning of conservation. Multiple purpose uses. Economic principles applied to natural resources; their use and development. Appraisal of public interest and public controls, programs, and policies.

512. AGRARIAN REFORM AND ECONOMIC DEVELOPMENT.
(3-0) Cr. 3. S.
Prerequisite: 307 or 434. Timmons.
Meaning of economic development, underdevelopment, overpopulation, agrarian structures as obstacles to economic development. Improving agrarian structures through national, regional, and United Nations actions. Comparative structural change in countries.

515. INDUSTRIAL STRUCTURES AND COMPETITION.
(3-0) Cr. 3. F.
Prerequisite: 502. Fletcher, Harl, Merrill.
Business concentration in the American economy; structures and competitive practices of particular industries; mergers, vertical and horizontal integration; measurement and evaluation of competition and monopoly; economic problems of public control of competition.

461: Theories of urban development; city typology and measurement; land-use analysis; trade and commuting patterns; urban economic interdependence; social investment in metropolitan communities. 462: Regional growth and efficiency; the locational determinants of firms and households; the regional economic base; resource development; economic planning in the city-region.

465. ECONOMICS OF EDUCATIONAL SYSTEMS.
(3-0) Cr. 3. W.
Prerequisite: 242, or permission of instructor. Economic problems of public education, such as resources within school systems; economic analysis of resources available to schools and school systems; economic aspects of human resource development pertinent to education; interrelationships among an area's school system, its population and its resource base.

466. RETAILING.
(3-0) Cr. 3. S.
Prerequisite: 242.
Economic nature of retailing; retail market structure; store organization; merchandising and pricing policies; retail control.

490. SPECIAL PROBLEMS.
Cr. 1 to 5 each time taken. F.W.S.
Prerequisite: 242, senior classification.
A. Agricultural Economics.
B. Economics.
H. Honors Program.

*Administered by the College of Agriculture. Courses not marked by an asterisk are administered by the College of Sciences and Humanities.
531. AGRICULTURAL MARKET ORGANIZATION AND BUSINESS BEHAVIOR.  
(3-0) Cr. 3. F.  
Prerequisite: 501. Fletcher.  
Critical review of the theory of industry organization and firm behavior; analysis of the structures and competitive processes in agricultural product and factor markets; evaluation of economic performance under alternative normative criteria; legal restraints and marketing control programs.

532. QUANTITATIVE METHODS IN AGRICULTURAL MARKETING RESEARCH.  
(3-0) Cr. 3. W.  
Prerequisite: 501, credit or classification in Stat. 402. Ladd.  
Examination of models and theories from economics and other social sciences relevant to marketing and forecasting problems; use of these models and their hypothesis formulation; selection and use of quantitative techniques.

533. RESEARCH DESIGN IN AGRICULTURAL MARKETING.  
(3-0) Cr. 3. B.  
Prerequisite: 501. Doak, Scott.  
Current problems in agricultural markets and marketing; integration of theory, models, techniques and data in problem formulation; role of information in decision processes; research objectives, organization and financing—state, federal and industry; dissemination and application of research findings.

534. ECONOMIC DEVELOPMENT AND TRANSFORMATION OF AGRICULTURE.  
(3-0) Cr. 3. Alt. W, offered 1972.  
Prerequisite: 501. Heady.  
Relation of economic growth to factor prices and the technological and firm structure; firm behavior and aggregate response in product supply and factor demand; developmental needs for transformation of agriculture and resource mobility; supply and resource problems under different stages of development; policy needs for alternative problems in development.

535. BUSINESS FLUCTUATIONS.  
Prerequisite: 409 or 603. Brady, Starleaf.  
Dynamic theories of fluctuations in aggregate demand and aggregate economic activity.

536. LINEAR ECONOMIC MODELS.  
(3-0) Cr. 3. F.  
Prerequisite: 307, Math. 104, Ladd.  
Selected applications of mathematics to economic problems; includes game theory, linear programming, and input-output analysis.

537. ECONOMETRIC STATISTICS.  
(Stat. 534) See Statistics.

538. OPERATIONS RESEARCH.  
(Stat. 539) See Statistics.

539. OPERATIONS RESEARCH METHODS AND ECONOMIC ANALYSIS.  

544. THEORY OF PUBLIC GOODS AND EXTERNALITY.  
(3-0) Cr. 3. F.  
Prerequisite: 501. Davis, Meyer.  
Public goods, externality and social choice, public choice.

545. ECONOMICS OF TAXATION.  
(3-0) Cr. 3. W.  
Prerequisite: 503. Davis, Meyer.  
Taxation, shifting and incidence, public debt, fiscal federalism.

548. QUANTITATIVE AGRICULTURAL PRICE ANALYSIS.  
(3-0) Cr. 3. B.  
Prerequisite: 307, Doak, Scott.  
Measurement of supply and demand for agricultural products. Integration of government reports into outlook information for planning purposes by agricultural producers and marketing firms. Collection and analysis of price and quantity information.

551. MONETARY THEORY.  
(3-0) Cr. 3. F.  
Prerequisite: 503. Christian, Luckett.  
The monetary mechanism: Neoclassical theory, neo-Keynesian monetary theory and the portfolio approach, microeconomic aspects of monetary theory, including monetary determinants of cost of capital. Rate of interest, expectations and lag in effect of monetary policy. Money supply theory.

552. ADVANCED MONEY AND BANKING.  
(3-0) Cr. 3. W.  
Prerequisite: 503. Christian, Luckett.  
Theory and structure of commercial banking, the money and capital markets, financial intermediaries, and the Treasury with respect to central banking and monetary policy.

555. ADVANCED INTERNATIONAL ECONOMICS.  
(3-0) Cr. 3. W.  
Prerequisite: 307. Cheng, Thorbecke.  
Modern theory of international pricing and allocation; foreign trade multiplier and international monetary equilibrium; problems of international economic stability; multilateral trade and economic development.

556. REGIONAL ECONOMICS.  
(3-0) Cr. 3. Alt. W, offered 1972.  
Prerequisite: 502. Prescott.  
Theories of regional growth. Characteristics of viable economic regions. Spatial-economic models of urban and resource development.

557. ADVANCED INTERNATIONAL FINANCE.  
(3-0) Cr. 3. S.  
Prerequisite: 409; 503 and 555 recommended. Cheng.  
Theory of foreign exchange, mechanism of adjustments in the balance of payments, exchange speculation and the forward exchange market, selected topics in international monetary policy.

561. AGRICULTURAL RESOURCE AND INCOME PROBLEMS.  
(3-0) Cr. 3. F.  
Prerequisite: 308. Kaldor.  
Analysis of adjustment, instability, and income problems and their interrelationships; forces of
agricultural disequilibrium, adaptability of the farm industry; sources of short-run price and income instability; farm family income problems related to structural imbalance and inadequate resources.

*562. AGRICULTURAL PRICE AND INCOME POLICY.
(3-0) Cr. 3. W.
Prerequisite: 561. Bell, Kaldor.
Short- and long-run objectives of farm price and income policy; analysis and appraisal of agricultural price and income programs.

*563. CONTEMPORARY ISSUES IN AGRICULTURAL POLICY.
(Pol.S. 563) (3-0) Cr. 3. S.
Prerequisite: 447, Pol.S. 473 recommended. Hendelger, Kaldor, Tablitz.
Politic-economy analysis of current agricultural policy issues. A major issue selected for analysis in depth. Underlying value judgments and empirical relationships identified and analyzed. Political acceptability of alternative solutions appraised.

565. ECONOMICS OF LOCATION.
(3-0) Cr. 3. Alt. S, offered 1972.
Prerequisite: 501. Faden.

566. URBAN ECONOMICS.
(3-0) Cr. 3. Alt. S, offered 1973.
Prerequisite: 501. Faden, Prescott.
History of world urban development; economic foundations of the city, agglomerating forces, linkage; theories of city growth—ring theories, sectoral theories, multiple nucleation; city system and urban hierarchies, core-suburban, hinterland relations and size distributions; commuting patterns, land-use patterns, CBD functions; metropolitan problems, transportation, housing, congestion, and neighborhood effects.

570, 571. ECONOMIC DEVELOPMENT AND GROWTH.
(3-0) Cr. 3 each. 570: P; 571: W.

573, 574. APPLIED ECONOMETRIC MODELS.
(3-0) Cr. 3 each. 573: W; 574: S.
Prerequisite: 573: 538; 574: 573. Stephenson and staff.
Selected applications of econometric techniques to economic models.

576. REGIONAL ECONOMIC PLANNING.
(3-0) Cr. 3. Alt. S, offered 1972.
Prerequisite: 307. Prescott, Van de Wetering.
Regional economic aspects of resource management; role of economic information in physical planning. Problems of public policy for control and use of natural and human resources in regional development. Applications of systems analysis to public planning in river basins and metropolitan regions.

590. SPECIAL TOPICS.
Cr. 1 to 3 each time taken.
A. Agricultural Economics.
B. Economics. Topics will be chosen from, but not limited to: (1) Economic analysis of rural-urban educational systems. (2) Information economics and systems analysis.

591. COMPARATIVE TRADE UNIONISM.
(3-0) Cr. 3. Alt. S, offered 1973.
Prerequisite: 502. Davey.
Analytical survey of contemporary trade unionism in the United States and selected Western European countries, with special emphasis on the transferability of objectives, procedure, and techniques of trade union movements in newly emerging nations and economically underdeveloped areas.

592. ECONOMICS OF THE LABOR MARKET.
(3-0) Cr. 3. Alt. F, offered 1971.
Prerequisite: 502. Jakubauskas.
Advanced research and analysis of current problems of manpower development and utilization, unemployment and underemployment, and changes in the industrial and occupational composition of the labor force.

593. WAGES AND THEORIES OF WAGE DETERMINATION.
(3-0) Cr. 3. Alt. F, offered 1972.
Prerequisite: 502. Palomba.
Macro and micro wage theory, the economic and institutional forces determining wage levels and differentials, theory of bargaining power in wage determination.

594. COMPARATIVE MANPOWER DEVELOPMENT.
(3-0) Cr. 3. Alt. W, offered 1973.
Prerequisite: 502. Jakubauskas.
Strategies for the development of human resources in developing economies; manpower development planning; the relationship of economic development to education, training, and manpower utilization.

595. LAW OF LABOR RELATIONS.
(3-0) Cr. 3. Alt. W, offered 1972.
Prerequisite: 305. Davey.
Federal and state legislation affecting the collective bargaining process, including analysis of selected court decisions. Role of government in adjustment of labor disputes. Legal aspects of labor arbitration.

596. ECONOMICS OF COLLECTIVE BARGAINING.
(3-0) Cr. 3. Alt. S, offered 1972.
Prerequisite: 502. Davey, Palomba.
Economic effects of collective bargaining at both the microeconomic and macroeconomic levels. Union wage policy and employment effects. Wage-price-profit-productivity relationship. Economic aspects of adjustment to technological change through collective bargaining.

*Administered by the College of Agriculture. Courses may be noted by an asterisk and administered by the College of Sciences and Humanities.

COURSES FOR GRADUATE STUDENTS,

601, 602, 603. ADVANCED ECONOMIC THEORY.
(3-0) Cr. 3 each Yr.
Prerequisite: 601: 503; 602: 601; 603: 602. Brady, Starleaf, Stephenson, staff.
605, 606. HISTORY OF ECONOMIC THOUGHT.
(3-0) Cr. 3 each. 605: F; 606: S.
Prerequisite: 602, 603. Luckett.
Principal figures in the development of economic ideas; contribution of each period of economic thought. 605: The Mercantilists to the Classical School, inclusive. 606: Critic's of the Classical School to J.M. Keynes.

614. 615. ADVANCED THEORETICAL ANALYSIS.
(3-0) Cr. 3 each. 614: F; 615: W.
Prerequisite: 614: 502, Math. 204 or 307, 409; 615: 614. Faden, Van Moeseke.
614: The axiomatic method. Local and global equilibrium of the consumer, producer, and general equilibrium of the firm. Preference indifference, (continuous) numerical representation and derivation from the revealed-preference axioms. Equilibrium of the market with continuum of traders. Effective coalitions and core allocations. Speculation of the efficiency theorems to activity analysis; price-guided allocations.

*630. ADVANCED NATURAL RESOURCE ECONOMICS.
(3-0) Cr. 3. F.
Prerequisite: 308 or 434. Harl, Thomas, Timmons.

*634. LAND VALUATION.
(3-0) Cr. 3. S.
Prerequisite: 307. Murray.
Factors determining land value; fluctuation in land prices; critical evaluation of appraisal methods.

*635. FARM CREDIT THEORY.
(3-0) Cr. 3. W.
Prerequisite: 307; 308 recommended. Murray.
Farm credit policies and methods of extending credit. Organization and operation of lending agencies, private and governmental. Evaluation of alternative agricultural credit systems.

638. ADVANCED ECONOMETRIC STATISTICS.
(Stat. 638) See Statistics.

*641. ECONOMICS OF AGRICULTURAL PRODUCTION.
(3-0) Cr. 3. F.
Prerequisite: 501. Heady.
Production principles applied to use of land, labor, and capital: static and dynamic firm theory; farm size; resource and product combinations; production location; timing of production and conservation; cost structure; leases and asset control; uncertainty and expectations.

*642. RESOURCE EFFICIENCY AND ALLOCATION IN AGRICULTURE.
(3-0) Cr. 3. W.
Prerequisite: 641. Heady.
Efficiency criteria; inter-industry productivity comparisons; technological change; resource mobility; firm-household interrelationships; returns to farm and society; causes of and means for eliminating production inefficiency.

645. MATHEMATICAL METHODS IN ECONOMIC THEORY.
(3-0) Cr. 3. S.
Prerequisite: 615. Van Moeseke, Sengupta.

646. TIME SERIES.
(Stat. 646) See Statistics.

660. WELFARE ECONOMICS.
(3-0) Cr. 3. S.
Prerequisite: 602. Holdren.

*670. RESOURCE ALLOCATION IN FORESTRY.
(For. 670) See Forestry.

672. CAPITAL AND GROWTH.
(3-0) Cr. 3. Alt. S, offered 1972.
Prerequisite: 570, 603. Sengupta.
Theories of capital accumulation and multisection models of economic growth; optimum and efficient growth; applications to planning and resource allocation models; stochastic process applications.

690. SEMINAR.
Cr. 1 to 3 each time taken. F.W.S.
Prerequisite: Six credits of graduate work in chosen field.
Current topics in economic theory and applied economics. Offerings each quarter will be selected from the following list:
A. Industrial Organization.
B. International Economics.
C. Economic Development and Policy.
D. Monetary Economics.
E. Public Finance.
F. Urban-regional Economics.
*G. Agricultural Marketing and Price Analysis.

696A, 696B, 696C. THEORY OF QUANTITATIVE ECONOMIC POLICY.
(3-0) Cr. 3 each. Yr.
Prerequisite: Permission of Instructor. Sengupta, Thorbecke, Van de Wetering.
696A: Formulation and specification of policy models applied to problems of economic stabilization and economic development, mainly at the national level. Economic forecasting and reliability analysis for economic policy models. 696B: Economic policy models and the theory of optimal control. Specification and computation of optimum policy in dynamic economic models. Certainty equivalence theorems and decision rules. Continuous and discrete versions of the maximum principle and their economic applications to growth, stabilization, and other problems. 696C: Economic policy models at the sectoral level. Sectoral planning applied to agriculture, transportation, education, and other sectors. Changes in technology and their effects on sectoral objectives.

699. RESEARCH.
*A. Agricultural Economics.
B. Economics.

*Administered by the College of Agriculture. Courses not marked by an asterisk are administered by the College of Sciences and Humanities.
EDUCATION

Ray J. Bryan, Ph.D., Professor in Charge, Professional Studies
Harold E. Dilts, Ph.D., Professor in Charge, Secondary Education


Instructors: Leslie A. Anderson, M.S.; Joseph F. Bendixen, Ph.D.; Elizabeth E. Buckels, M.S.; Dorothy Hadley, M.S.; Dwayne G. Olsen, M.A.; Sharon Redick, M.A.; Donna J. Thompson, M.A.; Richard A. Wilson, M.S.; Ivan G. Youngberg, M.A.

Undergraduate Study

Students seeking recommendations for a certificate to teach in the secondary schools must be admitted to the teacher education program and pursue a program which includes the following professional sequence courses: Educ. 204, 305A, 305B, 426; Psych. 230, 333; special methods, and student teaching in the area of specialization. All students who are recommended by Iowa State University for teacher certification must be recommended by the College of Education. However, each student will be enrolled in the department in which he plans to major, and he must meet the graduation requirements of that department and the college in which it is located. For specific requirements for each area of specialization, see College of Education, Curricula and Curricula for the college in which the chosen degree major is sought.

Graduate Study

The College of Education offers work for the degrees Master of Science, Master of Education, and Doctor of Philosophy in education with major work in education or in industrial education, and minor work to students taking major work in other departments. Within the education major, a student may specialize in adult education, educational administration, higher education, evaluation, extension education, guidance and counseling, and philosophy of education. Within the industrial education major, a student may specialize in vocational-technical education.

Prerequisite to major graduate work in education is preparation substantially equivalent to the completion of one of the undergraduate curricula in education offered at Iowa State
University and adequate proof that the student ranks above average in scholastic ability and promise of professional competency.

There is no language requirement for the degrees Master of Science or Master of Education. A satisfactory reading knowledge of two languages selected from French, German, Russian, or Spanish is required of doctoral candidates. At the discretion of the student’s graduate program committee, the foreign language requirement may be met by: (1) demonstrating a satisfactory reading knowledge of two of the languages named; (2) demonstrating a significantly higher degree of competence in one of the named languages; (3) substituting two years of undergraduate study in the language with a B average for one of the above languages; or (4) substituting nine quarter credits of graduate work in addition to the minimum Ph.D. requirements in approved areas for one language or 18 credits for two languages. Students whose native language is not English may substitute competence in English for one of the languages.

Other graduate programs related to education may be planned for students on the basis of previous education and experience as well as future plans and needs. Students should refer to the Index and to graduate level course offerings under Courses and Programs for their area of interest.

Open to graduate students for minor credit only: Educ. 426, 468.

COURSES PRIMARILY FOR UNDERGRADUATE STUDENTS

204. FOUNDATIONS OF AMERICAN EDUCATION.
(3-0) Cr. 3. F.W.S.S.S.
Place of education in democracy; American public school system; modern objectives of education; legal, personal, and professional qualifications for teaching.

230. DEVELOPMENTAL PSYCHOLOGY.
(Psych. 230) See Psychology.

305. METHODS OF TEACHING.
A. (3-0) Cr. 3. F.W.S. S.S.
Prerequisite: 204, classification in Psych. 333, enrollment in approved teacher education program, junior classification.
A. Current educational methods and their subsequent utilization in the classroom. Special emphasis on unit planning, objective formation, and teaching techniques.
B. Instructional Media.

333. EDUCATIONAL PSYCHOLOGY.
(Psych. 333) See Psychology.

365. MUSIC IN ELEMENTARY EDUCATION.
(Music 365) See Music.

366. MUSIC IN GENERAL EDUCATION.
(Music 366) See Music.

416. ART METHODS FOR SECONDARY SCHOOLS.
(A.A. 416) See Applied Art.

417. OBSERVATION AND SUPERVISED TEACHING—SECONDARY SCHOOLS.
(Ag.Ed. 417) See Agricultural Education.
(A.A. 417) See Applied Art. (D.St. 417) See Distributed Studies.
(H.Ed. 417) See Home Economics Education.

418. OBSERVATION AND SUPERVISED TEACHING—ELEMENTARY SCHOOLS.

426. PRINCIPLES OF SECONDARY EDUCATION.
(3-0) Cr. 3. F.W.S.S.S.
Prerequisite: 305 or equivalent.

Problems of teacher relationships; pupil management and guidance; the curriculum; extra-curricular activities; trends in education; secondary school population; community school; evaluation of pupil progress; codes of professional ethics.

468. EXTENSION EDUCATION.
(3-0) Cr. 3. F.
Praerequisite: Permission of instructor.
History and philosophy of university extension education; objectives, organization, and programs of university extension. Principles and procedures of instruction and evaluation in extension education.

476. METHODS OF TEACHING FOREIGN LANGUAGES.
(F.L. 476) See Foreign Languages.

486. METHODS OF TEACHING SCIENCE.
(D.St. 486) See Distributed Studies.

490. SPECIAL PROBLEMS.
Cr. 1 to 6.
Praerequisite: Junior classification, quality-point average of 2.5 or more for preceding two quarters.
A. Music Education. (Music 490A) See Music.
B. Vocational and Educational Guidance.
C. Curriculum Construction.
D. Principles of Education.
E. Methods of Teaching.
H. Honors Program.
I. Foundations of Educational Statistics.
S. Foundations of Education.

494. THE TEACHING OF ENGLISH.
(Engl. 494) See English.

495. THE TEACHING OF SPEECH.
(Sp. 495) See Speech.

496. METHODS OF TEACHING SOCIAL STUDIES.
(D.St. 496) See Distributed Studies.

497Y. TEACHING OF SECONDARY SCHOOL MATHEMATICS.
(Math. 497) See Mathematics.

497Z. METHODS OF TEACHING PHYSICAL EDUCATION.
(P.E.M. 497) See Physical Education for Men.
COURSES PRIMARILY FOR GRADUATE STUDENTS, major or minor, open to qualified undergraduates

501. SOURCES, SELECTION, AND PREPARATION OF EDUCATIONAL MEDIA.
(2-2) Cr. 3. F.S.SI.
Prerequisite: 305B. Volker.
Organization of educational media centers. Sources and selection of software and hardware. Analysis of current research in effectiveness of teaching and learning through media. Projection of a variety of teaching materials.

502. PRODUCTION OF VISUAL MEDIA.
(2-2) Cr. 3. W.
Prerequisite: 501. Volker.
Designing, scripting, and producing film loops, photo essays, and video tapes. Implementation of research in development of effective multimedia materials.

503. DESIGNING INSTRUCTIONAL SYSTEMS.
(2-2) Cr. 3. S.
Prerequisite: 502. Volker.
Designing, scripting, and producing multi-media presentations for individual or group instruction. Research methods of evaluating multi-media instruction.

515. EVALUATION OF EDUCATIONAL OUTCOMES.
(3-0) Cr. 3. W.S.S.
Prerequisite: Fifteen credits in education. Howe.
Methods of evaluating educational outcomes, types of tests and their construction, use and interpretation of educational materials in teaching.

517. SUPERVISION OF STUDENT TEACHERS AND OTHER PREPROFESSIONAL LABORATORY EXPERIENCES.
(3-0) Cr. 3. SS.
Prerequisite: Permission of instructor. Schloetke.
Designed for elementary and secondary school teachers. Emphasis is placed on the cooperating teacher's role relative to student teachers and teaching interns. Consideration is given to such topics as the orientation and guidance of future teachers, practical value of observation, cooperating teacher-student teacher planning, and continuous evaluation throughout the program.

520. TEACHING STRATEGIES AND ELEMENTARY SCHOOL ORGANIZATION.
(5-0) Cr. 6. F.S.SSI.
Prerequisite: Ed.Ed. 344, Psych. 333. Hohl.
The role of the school organization in the development and the utilization of teaching strategies and the effect of various strategies on learning.

522. PRINCIPLES OF CORRECTIVE READING.
(3-0) Cr. 3. W.S.SSI.
Prerequisite: 520. Merkley.
Identification, symptoms, causes, assessment, and correction of reading problems within the elementary classroom instructional program.

530. PRINCIPLES AND PRACTICES OF GUIDANCE.
(3-0) Cr. 3. W.SS.
Prerequisite: Fifteen credits in education and psychology, including Educ. 426 and Psych. 333. Bryan, Hopper, Pellegrino.
Principles and practices in the guidance services; individual inventory, informational services, counseling, placement, follow-up, assisting school staff, and coordination of school, home, and community efforts.

531. ANALYSIS OF THE INDIVIDUAL.
(2 or 3-0) Cr. 2 or 3. F.W.SS.
Prerequisite: 530, Psych. 440. Canute, Hopper.
Collection, organization, and interpretation of data pertinent to the study of pupils in relation to problems of educational and vocational planning and personal adjustment. Includes techniques for identifying the utilizing sources of information, analyzing, recording, and maintaining data about individual pupils.

532. GUIDANCE SERVICES IN THE ELEMENTARY SCHOOL.
(3-0) Cr. 3. F.S.SS.
Prerequisite: Educ. 530. Pellegrino.
Overview of current practices in guidance at the elementary school level; guidance services, roles of personnel involved, and the articulation of the elementary and secondary school guidance programs.

533A, 533B, 533C. COUNSELING STUDENTS.
(3-0) Cr. 3 each. 533A: F.S.SS; 533B: W.SS; 533C: W.SS.
Prerequisite: 530; 533B: 533A; 533C: 533B.
Hopper, McMillen, Miller, Pellegrino.
533A: Introduction to School Counseling. Consideration of major approaches to counseling elementary and secondary school students. 533B: Techniques of Counseling Secondary School Students. Interviewing with students, role playing, the observation of counseling. 533C: Techniques of Counseling Elementary School Students. Use of play media in counseling emphasized. Interviewing and observations of counseling.

534. ADMINISTRATION OF THE GUIDANCE SERVICES.
(2 or 3-0) Cr. 2 or 3. S.SS.
Prerequisite: 530. Bryan, Hopper, McMillen, Pellegrino.
Administrative principles and practices in organizing and implementing the guidance services.

536. GROUP PROCEDURES IN GUIDANCE.
(3-0) Cr. 3. F.S.SS.
Prerequisite: Permission of Instructor. Hopper, Pellegrino.
Methods for organizing, maintaining, conducting, and evaluating group counseling sessions.

536. ADULT EDUCATION.
(1 or 2-3) Cr. 2 or 3. F.
Prerequisite: Fifteen credits in education. Holmes.
Philosophy and need for continuing education in a democratic society. Survey of current trends in the areas of counseling, contributions of many agencies in the community. Focus upon the adult as a participant in continuing education.

537. METHODS OF TEACHING ADULTS.
(1 or 2-3) Cr. 2 or 3. S.SS.
Prerequisite: Fifteen credits in education or permission of instructor. Holmes.
Principles and practices of directing adult learning-experience activities. Techniques for leading adult groups in both formal and informal situations. Study and evaluation of various methods including creative techniques in group planning and decision making.

541. INTRODUCTION TO EDUCATION ADMINISTRATION.
(2 or 4-0) Cr. 2 or 4. F.S.SS.
Prerequisite: 426, Psych. 333. Engel.
Philosophy and purposes of education in a democratic society. Basic principles of school administration. Analysis of the nature and function of units of education at local, intermediate, and state levels; principles and procedures for their reorganization.
542. THE COMMUNITY PROGRAM OF SECONDARY EDUCATION.
(2 or 3-0) Cr. 2 or 3. S.SI.
Prerequisite: 426, Dita.
The academic and vocational programs of community high schools; extra-class activities; education programs for post-high school youth and adults; local community resources as curriculum content; curriculum revision.

543. THE ADMINISTRATION OF SCHOOL PERSONNEL I.
(2 or 3-0) Cr. 2 or 3. W.SSI.
Prerequisite: Fifteen credits in education. Engel. Selection and organization of the teaching staff; personnel policies; stimulation of professional growth; management of nonprofessional employees. Nature of leadership.

544. FACILITIES IN HIGHER EDUCATION.
(2 or 3-0) Cr. 2 or 3. S.SSI.
Prerequisite: 549. Hart.
Educational specifications for community college including socioeconomics, transportation and traffic systems, and population centers in geographic areas. The planning team. Curriculum, enrollment projections, and programming of required space needs.

545. THE COMMUNITY PROGRAM OF ELEMENTARY EDUCATION.
(2 to 4-0) Cr. 2 to 4. S.SI.
Prerequisite: Fifteen credits in education. Hohl. Problems of organization and administration of the elementary school program in relation to current theories and practices. Review of state courses of study; areas-of-living education; the fine arts; elementary school extra-class activities; community resources.

546. SCHOOL BUSINESS MANAGEMENT.
(3-0) Cr. 3. W.SSI.
Prerequisite: 541, Engel, Hart, Manatt.
Fiscal administration of local school systems; budgeting; financial accounting; auditing school accounts and other aspects of school business management, including insurance, transportation, buildings and grounds, and planning and construction.

547A. 547B. SUPERVISION OF INSTRUCTION.
(3-0) Cr. 3 each. 547A: S.SS; 547B: F.SS.
Prerequisite: Fifteen credits in education. 547A: Hohl. 547B: Engel, Manatt.

548. EDUCATIONAL POLICY MAKING AND INTERPRETATION.
(3-0) Cr. 3. W.SSI.
Prerequisite: 541. Engel.
Historical and legal bases of educational government in the United States; current issues in educational policy making at the local, state, and national levels; problems of implementing policy and interpreting educational programs to the community.

549. PLANNING PUBLIC SCHOOL FACILITIES.
(3-0) Cr. 3. S.SS.
Prerequisite: 541. Hart.
Assessment of need for new buildings; selection and acquisition of site; selection of architect; educational specifications; construction of new buildings.

551. OCCUPATIONAL INFORMATION.
(3-0) Cr. 3. F.W.SS.
Prerequisite: Fifteen credits in education and psychology. Bryan, Hopper, Jones.
Methods and techniques of occupational analysis, description and presentation of analysis, description and presentation of occupational information to high school pupils. Growth and development of important occupations, statistics, and trends. For teachers and counselors. Field trips to industrial plants.

552A. 552B. 553. EDUCATIONAL STATISTICS.
(3-0) Cr. 3 each. F.W.S.S.
Prerequisite: 552A: Fifteen credits in education, five credits in mathematics; 552B: Fifteen credits in education; 553: 552A, Howe, Netzel.
Statistical concepts and procedures for analyzing educational data. Designed for teachers, school administrators, or educational research workers. Concepts of descriptive and inferential statistics are stressed.

555. ORGANIZATION AND ADMINISTRATION OF JUNIOR HIGH-MIDDLE SCHOOL.
(2 or 3-0) Cr. 2 or 3. W.SS.
Prerequisite: 426, Manatt.
Current practices and trends in the organization of the junior high school, including underlying psychological and sociological theory. Responsibilities of the junior high school principal for scheduling, selection, and leadership of teaching personnel; records and reports; extracurricular activities; discipline; business administration.

556. ADMINISTRATION OF AREA VOCATIONAL-TECHNICAL SCHOOLS AND COMMUNITY COLLEGES.
(3-0) Cr. 3. W.SSI.
Prerequisite: 541, 543, 548 or equivalent. Brown. Scope, administration, organization, and evaluation of programs for area vocational-technical schools and community colleges.

560. HIGHER EDUCATION IN UNITED STATES.
(3-0) Cr. 3. F.SSI. Brown.
An introduction to the higher education system, including issues in community college programs. The development of higher education, the role of government in higher education, the financing of higher education, and the future of higher education. For graduate credits. Kizer.

561. METHODS OF COLLEGE TEACHING.
(2 or 3-0) Cr. 2 or 3. F.S.SSI.
Prerequisite: Fifteen graduate credits. Kizer.
Basic educational theory and methods; abilities essential to effective teaching.

562. CURRICULUM AND INSTRUCTION IN HIGHER EDUCATION.
(3-0) Cr. 3. W.SSII.
Prerequisite: Fifteen graduate credits. Brown.
Current issues and principles of curriculum development; experimental programs; relationships of general and specialized education; liberal education; professional education.

563. COLLEGE PERSONNEL POLICIES AND PRACTICES.
(3-0) Cr. 3. S.SSI.
Prerequisite: 560. Brown.
A profile of the college teacher, his special problems, interests, and goals; an examination of personnel problems in colleges and universities, including in-service development, salaries, fringe benefits, promotion, tenure, retirement, and recruitment will also be discussed.

564. STUDENT PERSONNEL SERVICES IN HIGHER EDUCATION.
(3-0) Cr. 3. W.SS.
An introduction to the field of student personnel work, with a consideration of student activities, counseling services, financial aid, admissions, student conduct, and residential programs. Includes study in community college programs.
565. ORGANIZATION AND ADMINISTRATION OF 
STUDENT PERSONNEL SERVICES IN 
HIGHER EDUCATION. 
(3-0) Cr. 3. S.SS. 
Organizational structures considered; role and 
functions of members of student personnel staff; 
policies and decision making for student 
personnel services emphasized.

570. PROGRAM PLANNING IN ADULT 
EDUCATION. 
(3-0) Cr. 3. F. 
Prerequisite: 536. Beavers. 
Principles and procedures in identifying and 
appraising program opportunities in adult edu-
cation. Emphasis will be on involvement of 
participants and integration of information in 
selecting program objectives.

575. FUNDAMENTALS OF SCHOOL LAW. 
(3-0) Cr. 3. S.SS. 
Prerequisite: 541, 543. Engel, Manatt. 
Fundamentals and principles of law as related 
to the state and education, reorganization, liabil-
ity, board procedures, pupil regulation, condi-
tions of employment.

576A, 576B. DUTIES OF SCHOOL PRINCIPALS. 
(2 or 3-0) Cr. 2 or 3 each. 576A: F.SS; 576B: 
W. S.S. 
Prerequisite: 541. 576A: Holh; 576B: Engel, 
Manatt. 
576A: Elementary school organization for teaching 
and learning. Time allotments, staff utilization, 
team teaching, and student control. 
Executive and planning functions of the 
elementary school principal. Historical perspec-
tives of this management profession. 576B: Sec-
dary school organization, schedule making, man-
agement of pupil organizations, evaluation of pupil 
growth. Evaluation of the total program, staff 
utilization, and leadership.

584A, 584B. HISTORY OF EDUCATION. 
(2 or 3-0) Cr. 3. 584A: W; 584B: S.SII. 
Prerequisite: Fifteen credits of graduate work. 
Kizer, Kniser, Smith. 
584A: History of European Education. Educa-
tional practices and institutions in ancient Greece 
and Rome; medieval educational patterns; rise 
of universities; impact of the Renaissance, Refor-
mation, and Counter-Reformation; development 
of national systems of education with special 
attention to England, France, and the German 
area. 584B: History of American Education. 
European heritage; colonial institutions and prac-
tices; influences from Enlightenment; Jefferson 
democracy and the rise of tax support and state 
supervision; response to industrialization; edu-
cational reform movements; twentieth century 
developments and trends.

595. COMPARATIVE EDUCATION. 
(3-0) Cr. 3. S.SI. 
Prerequisite: Fifteen credits of graduate work. 
Smith. 
Development, principles, and uses of comparat-
e education; comparative analysis of selected ed-
cational systems, practices, objectives, and prob-
lems; specific countries treated will vary from 
time to time.

590. SPECIAL TOPICS. 
Cr. 1 to 5. 
Prerequisite: Fifteen credits in education.

COURSES FOR GRADUATE STUDENTS, major or minor

601. PHILOSOPHY OF EDUCATION. 
(3-0) Cr. 3. F.SSII. 
Prerequisite: Fifteen credits of graduate work in 
education. Kizer.

B. Adult Education. 
C. Secondary Education. 
D. Vocational Educational Guidance. 
E. Administration of Education. 
F. Supervision of Education. 
G. Techniques of Research in Education. 
H. Elementary Education. 
I. Science Education. 
J. Classroom Utilization of Audiovisual Aids, 
including Radio and Television. 
K. Higher Education. 
L. Extension Education. 
M. Curriculum. 
N. Philosophy, History of Comparative and 
International Education. 
O. Administration and Supervision of Physical 
Education for Women.

591. SUPERVISED FIELD EXPERIENCE. 
(0-3 to 9) Cr. 1 to 3. F.W.S. 
Prerequisite: Fifteen credits graduate work in 
special area. 
Supervised on-the-job field experience in special 
areas.

E. School Administration. 
F. Elementary School Guidance. 
G. Community College Student Personnel Ser-
vice.

J. Higher Education.

592. SUPERVISED PRACTICE IN COUNSELING. 
(1-6 to 8) Cr. 3 or 4. F.W.S.SS. 
Prerequisite: 592A: 533A, 533B or C, permis-
sion of instructor; 592B: Six credits of 592A 
and permission of instructor. 
A. Counseling Practicum. 
B. Supervision of Counseling Practicum. 
C. Secondary Education. Dilts, Manatt, 
Schloerke. 
D. Vocational Educational Guidance. Bryan, 
Hopper, Pellegrino. 
E. Administration of Education. Dilts, Engle, 
Hart, Holmes, Manatt. 
F. Supervision. Manatt. 
G. Research and Evaluation. Howe, Netusill. 
H. Elementary Education. Beard, Merkley. 
J. Curriculum. Dilts.

596. CURRICULUM CONSTRUCTION. 
(3-0) Cr. 3. W.S.SI. 
Prerequisite: Fifteen credits of graduate work 
in education. Dilts. 
An analysis of curriculum theories and prin-
ciples of curriculum construction. Survey of cur-
riculum trends, promising practices, and socio-
cultural factors affecting the curriculum.

Philosophical traditions of the ancient and me-
dieval world. Traditions of the modern world. 
Analysis and classification of contemporary 
American educational theories and philosophies.
602. CURRENT EDUCATIONAL ISSUES.
(2 or 3-0) Cr. 2 or 3. W.
Prerequisite: Fifteen credits in graduate work in education. Kizer.
Selected educational issues, movements, or problems in contemporary American education.

603. PHILOSOPHICAL IDEAS IN AMERICAN EDUCATION.
(3-0) Cr. 3. S.
Prerequisite: 601. Kizer.
An intensive analysis and criticism of selected educational theories and issues. Synthesis and evaluation of their bearing on educational theory and practice.

615. SEMINAR.
(1 to 3-0) Cr. 1 to 3. F.W.S.
B. Adult Education.
C. Secondary Education.
D. Guidance.
E. Educational Administration.
F. Supervision.
G. Research and Evaluation.
H. Elementary Education.
I. Higher Education.
P. Philosophy, History, and Comparative Education.

624. RESEARCH METHODS IN EDUCATION.
(3-0) Cr. 3. S.S.S.
Prerequisite: Fifteen credits in education. Howe.
Adaptation of research techniques to problems in education. Primarily for students preparing to write theses.

641. ADMINISTRATIVE PROBLEMS.
(3-0) Cr. 3. F. Alt. S.SI, offered 1972.
Prerequisite: 541, 543. Engel.
A case-study approach to problems in educational administration. Focuses on the development of competences for dealing with actual situations.

643. THE ADMINISTRATION OF SCHOOL PERSONNEL II.
(3-0) Cr. 3. S.
Prerequisite: 543. Engel.
An in-depth exploration of problems in the administration of school personnel in relation to current theories and practices. Topics will include collective negotiation, differentiated staffing, and personnel selection and maintenance.

644. EDUCATIONAL FINANCE.
(2-4) Cr. 2 to 4. S.
Prerequisite: 541. Hart.
Application of the principle of public finance to education; school revenues and expenditures as part of the fiscal problem of government at the local, state, and federal levels.

663. RESEARCH IN THE ANALYSIS OF TEACHING.
(3-0) Cr. 3. S.
Prerequisite: Nine credits of graduate work in education. Dills, Schloerke.
Critical examination of various systems for studying and evaluating teaching: descriptive studies and conceptual systems of teaching; their nature and possible uses; major research attempts in assessing teaching effectiveness along with ensuing problems connected with such efforts.

664. COLLEGE ORGANIZATION AND ADMINISTRATION.
(3-0) Cr. 3. F.
Prerequisite: 560. Brown, Gowen.
Lectures and discussions relating to administrative organization and behavior: communications, leadership, distribution of power, institutional report writing, job analyses, legal bases, and institutional governance.

665. FINANCING HIGHER EDUCATION.
(3-0) Cr. 3. W.
Prerequisite: 560. Brown.
Lectures, discussions, and individual investigation relating to financial administration in colleges and universities. Budgeting, space utilization, administration of sponsored research, fund raising, investments, examination of theories on expenditures. Designed for persons aspiring to college administration.

678. ADMINISTRATIVE THEORY IN EDUCATION.
(3-0) Cr. 3. S.
Prerequisite: Master's degree, permission of instructor. Manatt.
The historical background of current thinking in administration and organization; theoretical approaches to administration; analysis of functions and processes of administration as they apply to education. For experienced administrators.

679. ADVANCED ADMINISTRATIVE THEORY IN EDUCATION.
(3-0) Cr. 3. S.
Prerequisite: 678, Manatt.
Critical evaluation of the major research in systems analysis, operations research and prediction models as they apply to the management of schools and colleges. Simulation by in-basket techniques and computer. Model building from isomorphisms selected from management strategies in business and industry.

680. THE TEACHING-LEARNING PROCESS IN ADULT EDUCATION.
(3-0) Cr. 3. S.
Prerequisite: 570. Lawrence.
Examination into psychological and sociological factors in adult behavior as they affect learning; special emphasis on differences between adults and youth as learners and their implications for adult teaching. The inductive approach to adult learning will be emphasized.

699. RESEARCH.
Cr. arr.
Prerequisite: Fifteen credits in education.
ELECTRICAL ENGINEERING

Warren B. Boast, Ph.D., Head of Department


Undergraduate Study

For undergraduate curriculum in electrical engineering leading to the degree Bachelor of Science, see College of Engineering, Curricula.

Electrical engineers engage in research, development, design, application, management, and sales in electrical and associated industries. They apply the theories, circuits, and materials of electrical engineering toward improvements in all of the range of electrical devices, methods, and systems that render a service to mankind.

The curriculum in electrical engineering has been designed to enable the individual to develop his imagination and knowledge so that he can enter any of these fields according to his incentive, initiative, and talents.

Graduate Study

The department offers work for the degrees Master of Science, Master of Engineering, and Doctor of Philosophy with major in electrical engineering and minor work to students taking major work in other departments.

Minor work for electrical engineering majors is usually selected from mathematics, physics, chemistry, nuclear engineering, aerospace engineering, or the life sciences.

There is no foreign language requirement for the degrees Master of Science or Master of Engineering. The foreign language requirement for the degree Doctor of Philosophy consists of the completion, with grades of C or better, of one of the following foreign language sequences (or equivalent):

101, 102, 103 (French)
121, 122, 123 (Russian)
131, 132, 133 (German)
151, 152, 153 (Spanish)

The department also offers major work for the degree Master of Engineering at approved off-campus locations. A minimum of 12 credits for work taken in residence on the Iowa State University campus is required. Thesis requirements may differ from those for the Master of Science degree. For further information, see Off-Campus Courses.

Electrical engineering is quite diverse, especially at the graduate level. Thus students can find considerable course offerings and research opportunities in biomedical engineering, circuit theory, computer technology, control and information systems, electric energy sources...
and conversion, electromagnetic wave propagation, electronic devices, electronic materials, and power systems engineering.

The normal prerequisite to major graduate work in electrical engineering is the completion of undergraduate work substantially equivalent to that required of engineering students at this university. Because of the diversification in the electrical engineering graduate program, however, it is possible for a student to qualify for graduate study in some of the areas enumerated above, even though his undergraduate or prior graduate training has been in a discipline other than electrical engineering. Supporting work, if required, will depend on the student's background and his area of research interest. A prospective student from a discipline other than a curriculum in electrical engineering is urged to submit, with his application for admission, a statement of his proposed area of graduate study.

Courses normally will be offered as stated in the course description. Where no specific time of offering is stated, the course may be offered during any quarter provided there is sufficient demand.

Instruction in biomedical engineering is provided jointly by the Colleges of Engineering and Veterinary Medicine. Laboratory facilities are available in the Biomedical Engineering Building. See Biomedical Engineering for requirements.


COURSES PRIMARILY FOR UNDERGRADUATE STUDENTS

100. TECHNICAL LECTURE. (1-0) Cr. R; S.
Current electrical engineering thought and practices presented by staff members and visiting lecturers.

200. SEMINAR. Cr. 1 to 3 as arranged. H. Seminar in electrical engineering for honors program students.

205, 206. BASIC ELECTRIC CIRCUITS I, II. 205: (3-0) Cr. 3. F.W; 206: (3-0) Cr. 3. W.S.
Prerequisite: 205: credit or classification in Math. 112 and Phys. 223. 206: 205, credit or classification in Math. 213.

231. ELECTRICAL INSTRUMENTATION AND EXPERIMENTATION I. (1-2) Cr. 2. W.S.
Prerequisite: Credit or classification in 205.
Systems for measurement of electrical quantities—voltage, current, power, time, impedance.

232. ELECTRICAL INSTRUMENTATION AND EXPERIMENTATION II. (1-2) Cr. 2. F.S.
Prerequisite: 231, Com.S. 201, credit or classification in 206.
Experiment design and evaluation; applications to electrical measurement problems.

300. SEMINAR. (1-0) Cr. R; S.
Prerequisite: Junior classification.

308, 309. ELECTRIC CIRCUIT ANALYSIS AND DESIGN I, II. 308: (4-0) Cr. 4. F.W; 309: (3-2) Cr. 4. W.S.
Prerequisite: 308; 206, credit or classification in Math. 322; 309: 308.

313. ELECTRIC AND MAGNETIC FIELD THEORY I. (4-0) Cr. 4. F.S.
Prerequisite: Math. 213, Phys. 223.
Vector analysis, principles of electrostatic fields, energy and potential, capacitance, Laplace's equation and application to static and quasi-static problems, numerical solutions of Laplace's equation.

314. ELECTRIC AND MAGNETIC FIELD THEORY II. (4-0) Cr. 4. F.W.
Prerequisite: 313.
Principles of magnetostatic fields, magnetic circuits, inductance, Faraday's Law, displacement current, Maxwell's equations, introduction to wave concepts and energy flow in transmission lines and electromagnetic waves.

315. TELEVISION FUNDAMENTALS. (3-0) Cr. 3. W.
Prerequisite: Sp. 391.
Fundamentals of electronics. Radio and television broadcasting systems, standards and equipment, including the NTSC system. Cannot be used to meet graduation requirements for students in the College of Engineering.

317. ELECTROMECHANICAL DEVICES. (3-2) Cr. 4. W.S.
Prerequisite: 313, 314, E.M. 345.
Fundamentals of electromechanical energy conversion with emphasis on the physical phenomena involved in the interaction between electromagnetic fields and the mechanical forces. Typical devices which are best explained through an application of both field concepts and circuit concepts are discussed.

341, 342. DC AND AC CIRCUITS AND MACHINES. (3-2) Cr. 4 each. 341; 342.
Prerequisite: 341: Phys. 223, Math. 112; 342: 341.
342: Introduction to DC machines; three-phase
425. LINEAR INTEGRATED CIRCUITS.
(3-0) Cr. 3. W.
Prerequisite: 376.
Analysis and application of linear integrated circuits, including such topics as chip fabrication, monolithic differential and operational amplifiers, active filters, switching regulators, data sheet specifications.

426. PULSE AND DIGITAL CIRCUITS.
(3-3) Cr. 4. F.
Prerequisite: 376.
The diode and active devices in switching applications. Analysis and design of pulse and digital circuits such as linear sweeps, multivibrators, logic elements.
475. INTRODUCTION TO ANALOG SIMULATION AND COMPUTATION.
(1-3) Cr. 2. F.W.S.

COURSES PRIMARILY FOR GRADUATE STUDENTS, major or minor, open to qualified undergraduates

505, 506. CONTROL-SYSTEM ANALYSIS AND SYNTHESIS.
(3-0) Cr. 3 each. Offered as arr.
Prerequisite: 505: 404; 506: 505.
Analysis and synthesis of linear feedback systems using transfer-function and state-variable methods.

507, 508, 509. SEMICONDUCTOR DEVICE THEORY AND TECHNOLOGY.
(3-0) Cr. 3 each Yr.
Prerequisite: 507: 376; Phys. 303; 508: 507; 509: 508.
507: Review of semiconductor physics including transport properties. Extensive theory and basic technology of p-n junction diode devices including tunnel and IMPATT diodes. 508: Theory of bipolar transistors and other multijunction devices. Introduction to surface state phenomenon. 509: Theory of selected surface effect, optical, and bulk effect devices. The concept and basic technology of integrated devices.

518, 520. ELECTRIC AND MAGNETIC PROPERTIES OF MATERIALS.
(3-0) Cr. 3 each Yr.
Prerequisite: 518: Phys. 303 or 423; 519: 518, Phys. 513 or Met. 512; 520: 519.

525. INTRODUCTION TO GASEOUS AND PLASMA ELECTRONICS.
(3-0) Cr. 3. Offered as arr.
Prerequisite: 314, Phys. 303, ionization processes; diffusion and recombination; electron attachment; behavior of charged particles in fields; mobility; self-sustained processes; breakdown; glows; arcs and coronas; microwave breakdown; plasma oscillations; plasma interaction with electromagnetic waves; applications.

527. COMMUNICATION SYSTEMS ANALYSIS AND DESIGN.
(3-3) Cr. 4. S.
Prerequisite: 427.

531. NETWORKS AND LINEAR GRAPHS.
(3-0) Cr. 3. F. Alt. Yr. as arr.
Prerequisite: 309.

532. SYNTHESIS OF ELECTRIC NETWORKS.
(3-0) Cr. 3. Alt. Yr. as arr.
Prerequisite: 309.
Necessary and sufficient conditions and synthesis methods for realization of passive driving point functions.

533. SYNTHESIS OF ELECTRIC NETWORKS.
(3-0) Cr. 3. Alt. Yr. as arr.
Prerequisite: 532.
Approximations useful in network synthesis, synthesis of passive two-port networks.

534. SYNTHESIS OF ELECTRIC NETWORKS.
(3-0) Cr. 3. Alt. Yr. as arr.
Prerequisite: 533.
Synthesis of networks containing active elements and methods for synthesis of such networks.

539. MATRIX NETWORK ANALYSIS.
(3-0) Cr. 3. F.
Prerequisite: 309 or 442.
Matrix analysis of networks, port and terminal descriptions, linear vector space formulation and applications.

541. ADVANCED SYMMETRICAL COMPONENTS.
(3-0) Cr. 3. Alt. Yr. as arr.
Prerequisite: 487.
Calculation of sequence impedances, analysis of unbalanced systems and unbalanced conditions.

542. POWER SYSTEM PROTECTION.
(3-0) Cr. 3. Alt. Yr. as arr.
Prerequisite: 541.
Criteria for fault clearing, device coordination, relaying.

543. COMPUTER SOLUTIONS FOR POWER SYSTEMS.
(3-0) Cr. 3. Alt. Yr. as arr.
Prerequisite: 541; 539 or 506.
The study of algorithms adaptable to digital computers for load flow, fault, and stability problems.

544. DISTRIBUTION ENGINEERING.
(3-0) Cr. 3. Alt. Yr. as arr.
Prerequisite: 487.
Distribution components, design criteria, protective device coordination, secondary networks, voltage control.

546. ECONOMIC OPERATION OF POWER SYSTEMS.
(3-0) Cr. 3. Alt. Yr. as arr.
Prerequisite: 539.
Operation of systems on a minimal cost basis, theory of incremental loading, system losses, methods of computation.

547. HIGH VOLTAGE DC TRANSMISSION.
(3-0) Cr. 3. Alt. Yr. as arr.
Prerequisite: 314.
Transmission by direct current, inverter design, basic concepts of analog simulation and computation with applications to feedback systems.

490. SPECIAL PROBLEMS.
Cr. 1 to 5 as arr.
Prerequisite: Senior classification in E.E.
Investigation of an approved topic commensurate with the student's prerequisites, interest, and ability.
H. Honors.
COURSES FOR
618, 619. ADVANCED
551, 552. ELECTROMAGNETIC
565. MICROWAVE ENGINEERING I AND II.

COURSES FOR GRADUATE STUDENTS, major or minor

618, 619. ADVANCED TOPICS IN ELECTRICAL
MATERIALS. (3-0) Cr. 3 each time elected. Alt. Yr. as arr.
Prerequisite: 520.
A. Superconductivity.
B. Stimulated emission amplification.
C. Coupled wave phenomena.
D. Static and dynamic domain phenomena.

636, 637. LINEAR ACTIVE NETWORK THEORY. (3-0) Cr. 3 each. Alt. Yr. as arr.
Prerequisite: 638: 538; 637: 636.
641. 642. HIGH VOLTAGE ENGINEERING. (3-0) Cr. 3 each. Alt. Yr. as arr.
Prerequisite: 467, 525.
Need for high voltage, high fields, ionization, AC and DC corona, voltage transients, lightning and protection, insulator flashover, insulation coordination, circuit interruption, radio interference.

644. 645, 646. INTERCONNECTED POWER SYSTEM DYNAMICS. (3-0) Cr. 3 each. Alt. Yr. as arr.
Prerequisite: 644: 467, 539, 506 or 579; 645: 644; 646: 645.
Dynamic performance of interconnected power systems with emphasis on stability. Dynamic equation of a synchronous machine and its response to perturbations. Control equipment in a power system including voltage regulators, governors and load-frequency controls. Representation of system components including the machine, the controls, and the loads during transients. Power system stability and the solution of the dynamic equations for large and small impacts using modern methods of analysis.

647. SPECIALIZED ELECTRIC ENERGY SOURCES. (3-0) Cr. 3 each time elected. Alt. Yr. as arr.
Prerequisite: 451 or 314, 375; Phys. 303.
Study of specialized sources which convert various sources of energy into electric energy. Each time offered one of the following direct energy schemes will be discussed:
A. Photovoltaic generators (solar cells).
B. Thermionic converters.
C. Magnetohydrodynamic generators.
D. Other schemes.

650. NUMERICAL SOLUTIONS OF ELECTROMAGNETIC PROBLEMS. (3-0) Cr. 3. Offered as arr.
Prerequisite: 552, Math. 406.
Variational and perturbational techniques, field computation by moment methods of radiating and scattering devices, eigenvalue problems, optimization.

677, 678, 679. NONLINEAR SYSTEMS. (3-0) Cr. 3 each. 677: Yr. as arr.: 678 and 679: Alt. Yr. as arr.
Prerequisite: 677: 404; 678: 577, 677; 679: 678.

684. ADVANCED SWITCHING THEORY. (Com.S. 684) (3-0) Cr. 3. Offered as arr.
Prerequisite: 410, permission of instructor.
Sequential logic with emphasis on the formalisms.

685. ADVANCED LOGIC SYSTEMS. (Com.S. 685) (3-0) Cr. 3 each time elected. S.
Prerequisite: 586.
A. Specialized Processor Organization.
B. Pattern Recognition and Adaptive Systems.
C. Optical Systems.

688. COMPUTER SEMINAR. Cr. 1 to 3 each time elected. Offered as arr.
Prerequisite: 586.
Various computer topics of timely interest.

691, 692, 693. OPTIMAL CONTROL. (3-0) Cr. 3 each. 691: Yr. as arr.: 692 and 693: Alt. Yr. as arr.
Prerequisite: 691: 578; 692: 691; 693: 692.

699. RESEARCH.

ELEMENTARY EDUCATION
Jess R. Beard, Ed.D., Professor in Charge

Professor: Jess R. Beard, Ed.D.
Associate Professor: Elaine Merkley, Ed.D.
Instructors: Rosalind E. Engel, M.A.; Ann Hodges, M.A.; Jerald E. Johnson, M.S.; Ruth Jones, M.S.; Carole A. Remele, M.A.

Undergraduate Study
For the undergraduate curriculum in education, major in elementary education, leading to the degree Bachelor of Science, see Education, Curriculum.

The curriculum in elementary education is planned for persons who want to teach at the elementary school level. Students who enroll in elementary education must make application to and be accepted by the teacher education committee in elementary education and the Academic Standards Committee, College of Education prior to classifying in advanced elementary education courses. For admission and certification requirements, see College of Education.
Graduate Study

For students seeking graduate course work leading to advanced degrees in education, see Education.

COURSES PRIMARILY FOR UNDERGRADUATE STUDENTS

100. FRESHMAN ORIENTATION.
Cr. R: F.W.S.
Opportunities in elementary education, program planning, and personal development. Required of all freshmen majoring in elementary education.

200. SOPHOMORE ORIENTATION.
Cr. R: F.W.S.
Opportunities in elementary education, program planning, and personal development. Required of all sophomores majoring in elementary education.

240. LITERATURE FOR CHILDREN.
(C.D. 240) See Child Development.

300. TRANSFER ORIENTATION.
Cr. R: F.W.S.
Opportunities in elementary education, program planning, and personal development. Required of all transfer students majoring in elementary education.

337. DEVELOPMENT AND GUIDANCE IN LATER CHILDHOOD.
(C.D. 337) See Child Development.

344A. 344B. PRINCIPLES OF TEACHING IN THE ELEMENTARY SCHOOL.
344A: (2-0) 2 Cr. 344B: (0-2) 1 Cr. F.W.S.SS.
Prerequisite: 344A: Educ. 204, Psych. 333; 344B: Concurrent registration in 344A.
Current trends and issues in the elementary school. Admission to the teacher education program must be completed during the quarter.

375. THE TEACHING OF READING.
(6-0) Cr. 6. F.W.S.SS.
Prerequisite: 344.
The developmental approach to teaching reading in elementary schools using various approaches, techniques, and materials; emphasis on reading skills, literature, and content areas; evaluation procedures; current innovations and issues.

445. ELEMENTARY EDUCATION METHODS I.
(6-0) Cr. 6. F.W.S.SS.
Prerequisite: 344.
Strategies for teaching social studies and language arts in the elementary school. Use of children's literature in these areas.

446. ELEMENTARY EDUCATION METHODS II.
(4-0) Cr. 4. F.W.S.SS.
Prerequisite: 344, Math. 191.
Procedures for teaching mathematics and science to children. Discovery approach, innovative programs, and practical field experiences.

447. TEACHING IN THE KINDERGARTEN.
(3-0) Cr. 3. W.S.SI.
Prerequisite: 344.
Emphasis on growth and development, readiness for learning, planned curriculum experiences, and observation.

450. THE SCHOOL AND THE DISADVANTAGED LEARNER.
(3-0) Cr. 3. F.S.SI.
Prerequisite: Psych. 333, senior classification.
Introduction to the characteristics of the disadvantaged children of the poor; implications for school personnel in working with the child and his family.

451. TEACHING THE DISADVANTAGED LEARNER.
(3-0) Cr. 3. W.S.SI.
Prerequisite: 450, Psych. 333.
Introduction to learning characteristics of the disadvantaged with appropriate techniques for assessing and teaching these children.

452. FIELD EXPERIENCE AND PRACTICUM WITH DISADVANTAGED.
(1-27) Cr. 3 to 9. F.W.S.SSI.
Prerequisite: Credit or classification in 451. Individual study. May include study tours, working with community agencies, or teaching in schools of deprived areas.

455. TEACHING THE DISABLED LEARNER.
(3-0) Cr. 3. F.W.S.SI.
Prerequisite: 344.
Emphasis on recognition of characteristics, classroom screening techniques for identification, referral procedures, teaching techniques, and materials.

456. TEACHING THE EMOTIONALLY DISTURBED CHILD.
(3-0) Cr. 3. S.SSI.
Prerequisite: 344.
Classroom screening techniques for identification, referral procedures, and classroom practices and procedures.

460. GUIDANCE OF CHILDREN.
(C.D. 460) See Child Development.

467C. STUDENT TEACHING IN THE PRIMARY GRADES.
(0-24) Cr. 8. F.W.S.
Prerequisite: 375, 445, 446, cumulative grade-point average of 2.3. Reservation required.
Experience in teaching in the primary grades.

467D. STUDENT TEACHING IN THE INTERMEDIATE GRADES.
(0-24) Cr. 8. F.W.S.
Prerequisite: 375, 445, 446, cumulative grade-point average of 2.3. Reservation required.
Experience in teaching in the intermediate grades.

490. SPECIAL PROBLEMS.
Cr. 1 to 5.
Prerequisite: Junior classification, permission of head of department.
ENGINEERING

David R. Boylan, Ph.D., Dean of Engineering
Paul E. Morgan, M.S., Associate Dean
Burton J. Gleason, Assistant to the Dean

Professors: Lawrence R. Hillyard, M.S.; George R. Town, D.Engr.
Associate Professor: Milton L. Regness, M.S.
Assistant Professor: Herbert A. Harmison, M.S.

Undergraduate Study

For undergraduate curricula offered in the several departments of engineering leading to the degree Bachelor of Science, see College of Engineering, Curricula.

The orientation courses listed are required of all freshman engineering students in order to provide information that will help the student in his work in the College of Engineering and will also help him in deciding which curriculum he will follow after the first year.

COURSES PRIMARILY FOR UNDERGRADUATE STUDENTS

114, 115. ORIENTATION.
(1-0) Cr. R. 114: F; 115: W.
114: Nature of professional work in engineering. Methods of testing individual's aptitudes for engineering profession. 115: Nature of various branches of engineering and some fundamental considerations in selecting a career.

190. SPECIAL TOPICS.
Cr. 1 to 5 each time taken. Prerequisite: Engineering classification. Experimental courses or honors seminars pertaining to topics common to more than one engineering curriculum.

200, 300, 400. COOPERATIVE WORK.
Credit: Required of all cooperative students in engineering. Prerequisite: Permission of department head. 200: Work periods for students with sophomore standing in a regularly established cooperative work-study program in any engineering curriculum. 300: Work periods for juniors. 400: Work periods for seniors. Students must register for these courses prior to commencing each work period.

431A, 431B. HISTORY OF ENGINEERING.

COURSES PRIMARILY FOR GRADUATE STUDENTS, major or minor, open to qualified undergraduates

515. HISTORY OF TECHNOLOGY IN THE UNITED STATES.
(Hist. 515) (3-0) Cr. 3. S. Prerequisite: 431B. Historical review of technological development of developing countries, with emphasis upon United Kingdom, U.S., and Japan; factors affecting rate of development; analysis and comparison of current technological status of selected cultures in America, Africa, and Asia.

561. TECHNOLOGY IN DEVELOPING COUNTRIES.
(Hist. 561) (3-0) Cr. 3. F. Prerequisite: 431B.
ENGINEERING GRAPHICS

C. Gordon Sanders, M.A., Professor, Chairman of Department

Professors: Maurice W. Almfeldt, B.S.; James S. Rising, M.S.

Associate Professors: Carl A. Arnbal, M.S.; Joe V. Crawford, M.S.; Paul S. DeJong, M.E.; Milton L. Rogness, M.S.

Assistant Professors: Robert O. Butler, B.S.; Wayne C. Dowling, M.S.; Arvid R. Elde, M.S.; William A. Ellingson, M.S.; Gary A. Granneman, B.S.; Glenn B. McConnell, B.S.; Cletus R. Mercier, B.S.; Carl J. Sayre, M.S.

Instructor: Kerry G. Geringer, B.S.

Undergraduate Study

Engineering graphics is a visual method of expressing ideas by means of views, graphs, and diagrams for the purpose of gaining, interpreting, and communicating technical knowledge.

Engineers often use graphical procedures to translate mathematical solutions into a picture form that may be more understandable and more logically followed and checked than the mathematical form. Designers use graphics as a memory-fixing device while ideas are being considered and refined—as a visual retention of alternate solutions for comparative analysis. As a means of communication, graphics provides visual descriptions of objects or relationships that are compact, precise, and readily interpreted.

Proper training in graphics develops an individual’s ability to visualize and comprehend the nature of systems and things, to think rationally and imaginatively and to communicate ideas and technical information effectively. The engineering graphics courses provide frequent opportunities to express creative talents and give the student important background training in preparation for various other disciplines.

COURSES PRIMARILY FOR UNDERGRADUATE STUDENTS

161. FOUNDATIONS OF ENGINEERING GRAPHICS.
(2-4) Cr. 3. P.W.S.
Graphical Delineation including use of equipment, methods, and procedures. Freehand sketching in all areas. Orthographic projection of points, lines, planes, and solids. Pictorial projection including axonometric, oblique, and perspective. Conventional graphical practices including sections, standards, and basic dimensioning.

162. FOUNDATION FOR ENGINEERING DESIGN.
(2-4) Cr. 3. W.S.
Prerequisite: 161.
Elements in the design process including fundamental steps of procedure and the essence of creativity. Application of the design process through an open-end project. Preliminary exposure to computer-aided design. Graphical topics related to the design process.

235. ADVANCED GRAPHICAL PROBLEMS.
(0-3 to 15) Cr. 1 to 5. S.
Prerequisite: 162, permission of department head.
Advanced graphical theory and application in the several fields of engineering. Choices include patent drawings; advanced detailing; layout and assembly drawing; gears, cams, linkages. Map projections, contours, ratio charts. Production differentiation, graphical integration, graphical derivation of empirical equations, alignment charts and nomographs.

341. ARCHITECTURAL GRAPHICS I.
(2-4) Cr. 3. F.

342. ARCHITECTURAL GRAPHICS II.
(2-4) Cr. 3. W.
Prerequisite: 341.
Spatial geometry involving angles, piercing points, and clearances. Rotation. Study of plane, single curved, double curved, and warped surfaces. Intersections of surfaces. Shadows and shade lines.

343. ARCHITECTURAL GRAPHICS III.
(2-4) Cr. 3. S.
Prerequisite: 342.
Perspective drawing, shadows and shades. Applications to architectural presentation techniques and methods.
ENGINEERING JOURNALISM

Administered by the Department of Industrial Engineering in cooperation with the Department of Journalism and Mass Communication.

A program in engineering journalism has been designed in the engineering operations curriculum for students who desire a knowledge of the fundamentals of management, engineering, science, communications, and human behavior, and who do not wish to pursue the more specialized engineering curricula. Graduates of this program should find interesting opportunities in a number of administrative areas in industry such as technical information, industrial communications, public relations, engineering sales, procurement, and production.

The program is administered in the Department of Industrial Engineering and leads to the degree Bachelor of Science with major in engineering operations. Additional information concerning the journalism courses and requirements may be obtained from the head of the Department of Journalism.

Required courses in the engineering journalism program include all the required courses in the engineering operations curriculum except as noted below.

<table>
<thead>
<tr>
<th>Course Details</th>
<th>Credits</th>
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<tbody>
<tr>
<td>101. Introduction to Mass Communication</td>
<td>2 credits</td>
</tr>
<tr>
<td>201, 202, 203. Basic Reporting, Writing, Editing</td>
<td>11 credits</td>
</tr>
<tr>
<td>At least four 300-level courses</td>
<td>12-14 credits minimum</td>
</tr>
<tr>
<td>At least three 400-level courses</td>
<td>9 credits minimum</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>34 credits minimum</strong></td>
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</tbody>
</table>

A 400-level journalism course, preferably 430, may be substituted for 1.Ad. 365A, and a 300-level course, preferably 360, for Engl. 414. Two courses selected from 425, 431, 440, 462, and 464 may be taken as socio-humanistic electives, and four other 300- and 400-level courses as management-business electives. In addition, the professional work requirement must be fulfilled. It consists of three months full-time experience or equivalent in professional mass communication work. (T.Jl. 490J—6 Cr.).

The minimum number of credits required for graduation in the engineering journalism program is 190, plus the professional work requirement.

ENGINEERING MECHANICS

Harry J. Weiss, D.Sc., Head of Department

Professors: Arthur W. Davis, Ph.D.; Herbert J. Gilkey, Sc.D.; Gundo A. Nariboli, Ph.D.; William F. Riley, M.S.; Donald F. Young, Ph.D.

Associate Professors: Frederick M. Graham, Ph.D.; Kenneth G. McConnell, Ph.D.; Jack S. Petersen, M.S.; Aldor C. Peterson, M.S.; Thomas R. Rogge, Ph.D.; Donald P. Smith, M.S.; Chang-Tsian Sun, Ph.D.; Yu-Min Tsai, Ph.D.

Assistant Professors: Lee A. Bertram, Ph.D.; Frank H. Brittain, Ph.D.; Lester W. Schmerr, Ph.D.; Frank Y. Tsai, Ph.D.; Jack L. Wood, Ph.D.

Undergraduate Study

The courses in mechanics are intermediate between those in physics and mathematics and the professional and design courses of the several engineering curricula. In the work of this department the student is expected to acquire an understanding of the principles underlying the technique of analysis and a knowledge of those properties of materials which influence the manner and extent of their use for engineering purposes. He is expected to gain
some insight into the background of purchase and design specifications. Physical properties of engineering materials are studied in the classroom and are evaluated in the laboratory. General laws, such as those of Newton, are given mathematical expression and are made suitable for use in the solution of specific problems in machine and structural design and in the flow and measurement of fluids.

Graduate Study

The department offers work for the degrees Master of Science, Master of Engineering, and Doctor of Philosophy with major in engineering mechanics, and minor work to students taking major work in other departments. The Master of Engineering degree is primarily a terminal master's degree, without thesis. There is no foreign language requirement for either master's degree or the Doctor of Philosophy degree.

The normal prerequisite to major graduate work is the completion of a curriculum substantially equivalent to that required of undergraduate students in engineering at this university. However, because of the diversity of interests in graduate work in engineering mechanics, it is possible for a student to qualify for graduate study even though his undergraduate or prior graduate training has been in a discipline other than engineering, e.g., physics or mathematics.

Courses open to graduate students for minor graduate credit only: 324, 325, 326, 327, 337, 345, 346, 354, 378, 420, 444, 490.

COURSES PRIMARILY FOR UNDERGRADUATE STUDENTS

274. STATICS OF ENGINEERING. (3-0) Cr. 3. F.W.S.S.S.
Prerequisite: Math. 112, credit or classification in Phys. 221.
Vector and scalar treatment of coplanar and noncoplanar force systems. Resultants, equilibrium, friction, centroids, moments and products of inertia of areas, Mohr's circle. Credit cannot be received for both 274 and 275.

275. SCALAR STATICS. (3-0) Cr. 3. F.W.
Prerequisite: Phys. 111, Math. 162.
Scalar treatment of coplanar and noncoplanar force systems. Resultants, equilibrium, friction, centroids, moments and products of inertia of areas, Mohr's circle. Credit cannot be received for both 274 and 275. This course is not acceptable as a prerequisite for 345.

324. STRENGTH OF MATERIALS. (5-0) Cr. 5. F.S.
Prerequisite: 274 or 275.
Plane stress, plane strain, stress-strain relationships, and elements of material behavior. Elements of stress and deformation analysis applied to members subject to centric, torsional, flexural, and combined loadings. Elementary considerations of theories of failure, buckling, repeated and impact loads. Credit cannot be received for both 324 and 325.

325. MECHANICS OF MATERIALS I. (3-0) Cr. 3. F.W.S.S.
Prerequisite: 274 or 275.
Plane stress, plane strain, stress-strain relationships, and elements of material behavior. Elements of stress and deformation analysis applied to members subject to centric, flexural, and torsional loads. Credit cannot be received for both 324 and 325.

326. MECHANICS OF MATERIALS II. (3-0) Cr. 3. F.W.S.S.
Prerequisite: 325.
Continuation of 325. Advanced topics on stress and deformation analysis of members subjected to torsional, flexural, and combined loading. Elementary considerations of theories of failure, buckling, repeated and impact loads.

327. MATERIALS LABORATORY. (0-3) Cr. 1. F.W.S.S.
Prerequisite: Credit or classification in 324 or credit in 325.
Experimental determination of mechanical properties of selected engineering materials. Experimental verification of assumptions made in 324. Use of strain measuring devices. Preparation of reports.

337. MATERIALS LABORATORY. (0-6) Cr. 2. F.W.
Prerequisite: Credit or classification in 354; credit in 325 or credit or classification in 324.
Similar to 327 with additional topics, and added emphasis on concrete. One-day inspection trip.

345. PARTICLE DYNAMICS. (3-0) Cr. 3. F.W.S.S.
Prerequisite: 274, Math. 213.
Vector and scalar treatment of coplanar and noncoplanar kinematics. Force-mass-acceleration, work-energy, and impulse-momentum methods applied to the motion of particles and systems of particles.

346. RIGID BODY DYNAMICS. (3-0) Cr. 3. F.W.S.S.
Prerequisite: 345, Math. 321.
Vector and scalar treatment of coplanar and noncoplanar kinematics. Force-mass-acceleration, work-energy, and impulse-momentum methods applied to rigid body plane motion, motion about a point, and general space motion.

354. ENGINEERING MATERIALS. (3-0) Cr. 3. F.W.S.
Prerequisite: Credit or classification in 324 or 325.
Properties, uses, and manufacture of metals, timber, stone, clay products, cements, concrete, and other engineering materials.
Courses and Programs

378. MECHANICS OF FLUIDS.
(3-2) Cr. 4. F.W.S.SSI.
Prerequisite: 504, 505, 506.
Properties of fluids. Fluid statics. Kinematics and kinetics of one-dimensional flow Impulse-momentum, dimensional analysis, flow in pipes and channels, engineering applications. Selected laboratory experiments.

420. INTRODUCTION TO MECHANICS.
(4-0) Cr. 4. F.
Prerequisite: Phys. 111 or 221; Math. 213.
Selected topics in applied mechanics, including statics and dynamics of rigid bodies, concepts of stress and deformation, equations of motion for continuous media, dynamics of perfect fluids, elastic behavior of solids, and viscous flow. May be elected by engineering students desiring a general review of mechanics. However, E.M. 420 is not available for credit toward graduation for students who have completed E.M. 325 or E.M. 378 or their equivalent.

444. MECHANICAL VIBRATIONS.
(3-0) Cr. 3. F.W.
Prerequisite: 324 or 325; 346.
Elementary vibration analysis, single and multiple degrees of freedom, energy methods, free and forced vibrations, viscous damping, transmissibility, influence coefficients, lateral vibrations of beams.

490. SPECIAL PROBLEMS.
Cr. arr.
Prerequisite: Permission of Instructor.
H. Honors.

* A student who is not present for the first laboratory meeting of his own section may qualify for continuation in the course only by attending the first laboratory meeting of some other section of either of these two courses.

COURSES PRIMARILY FOR GRADUATE students, major or minor, open to qualified undergraduates

504, 506, 508. ANALYTICAL METHODS IN MECHANICS.
(3-0) Cr. 3 each. 504: F.SSI; 505: W.SSII; 506: S.
Prerequisite: Math. 411.
Applications of the equations of heat conduction, potential theory, and wave propagation to problems in mechanics. Methods of solution.

514. ADVANCED MECHANICS OF MATERIALS.
(3-2) Cr. 3. F.
Prerequisite: 324 or 326.
Theory of stress and strain, stress-strain relationships. Limitations of flexure and torsion formulas, unsymmetrical bending, curved beams, cross shear, shear center. Torsion of thin-walled and noncircular sections. Theories of failure, membrane stresses in shells, thick-walled cylinders.

515. ELASTIC STABILITY.
(3-0) Cr. 3. Alt. W, offered 1973.
Prerequisite: 514 or credit or classification in 514.

517. EXPERIMENTAL STRESS ANALYSIS.
(3-2) Cr. 4. W.
Prerequisite: 324 or 326.
Fundamental concepts of strain measurement, properties of Stresscoat and its application, wire, foil and semiconductor strain gages, strain gage circuits and recording instruments, rosette analysis, analogies, introduction to photoelasticity and moire methods.

518. PHOTOELASTICITY AND MOIRE METHODS.
(3-2) Cr. 4. S.
Prerequisite: 324 or 326.
Two- and three-dimensional photoelasticity, compensation techniques, principal stress separation using shear difference, oblique incidence and other methods, birefringent coatings, scattered light, design of models, moire methods and their application.

519. EXPERIMENTAL METHODS OF MOTION MEASUREMENT.
Prerequisite: 517, 544.
Description, specifications, limitations, and applications of mechanical, electrical, and optical transducers used in motion measurements applied to steady state, transient, and shock motions. Calibration, signal conditioning, and transducer systems used to obtain reliable and reproducible experimental data. Seismic and absolute references for motion measurement.

544. MECHANICAL VIBRATIONS.
(3-2) Cr. 4. F.SSI.
Prerequisite: 325, 346.
Elements of lumped parameter linear systems, kinematics of vibrations, equations of motion for free and forced vibrations, energy methods, resonance, damping, multiple degrees of freedom, mechanical impedance, isolation and absorption of vibrations with impulsive and arbitrary excitation of linear systems, primary and residual shock spectra. Use of analog computers in analysis of vibration problems.

545. ADVANCED VIBRATION ANALYSIS.
(3-0) Cr. 3. Alt. W, offered 1972.
Prerequisite: 544. Math. 322.
Nonlinear vibrations, phase plane and approximate solutions. Multiple degrees of freedom, inertia and stiffness matrices, numerical methods. Vibration of continuous systems, limitations, and comparison of lumped approximations of continuous systems.

546. INTRODUCTION TO RANDOM VIBRATIONS.
(3-0) Cr. 3. Alt. S, offered 1972.
Prerequisites: 544.
Characteristics of random vibrations; random processes, probability distributions, spectral density and its significance, the normal or Gaussian random process. Transmission of random vibration, response of simple single and two-degree-of-freedom systems to stationary random excitation, failure due to random excitation.

548, 549, 550. ADVANCED ENGINEERING DYNAMICS.
(3-0) Cr. 3 each. Alt. Yr, offered 1972-73.
Prerequisite: 544, Math. 321.

555. LINEAR WAVE PROPAGATION.
(3-0) Cr. 3. Alt. F, offered 1971.
Prerequisite: 504.
Surfaces of discontinuity, wave-fronts, characteristics, retarded potentials; reflection and refraction.
fraction; anisotropy; dispersion and damping; phase velocity and group velocity; asymptotic methods.

566. ELASTIC PLATES.
(3-0) Cr. 3. Alt. W, offered 1972.
Prerequisite: 514 or 593.
Analysis of thin plates. Problems in the bending and buckling of thin plates.

568. PLASTICITY I.
(3-0) Cr. 3. Alt. W, offered 1973.
Prerequisite: 514 or 593.

569. INTRODUCTION TO LINEAR VisCOElasticITY.
(3-0) Cr. 3. Alt. F, offered 1972.
Prerequisite: 594.
Definition of linear viscoelastic material; simple mechanical models; generalized models, differential and integral constitutive laws. Boundary value problems, transform methods, correspondence principle, variational techniques.

571. 572, 573. ADVANCED FLUID MECHANICS.
(M.E. 571, 572, 573) 571: (3-2) Cr. 4. F; 572: (3-0) Cr. 3. W; 573: (3-0) Cr. 3. S.

COURSES FOR GRADUATE STUDENTS,
major or minor

604. ADVANCED TOPICS IN ANALYTICAL METHODS IN MECHANICS.
(3-0) Cr. 3. Alt. F, offered 1972.
Different geometry of curves and surfaces; perturbation methods in solid and fluid mechanics; self-similar solutions; variational methods, Kantorovich's method, applied aspects of functional analysis.

620. SEMINAR.
(1-0) Cr. 1.

630. CONTINUUM MECHANICS I.
(3-0) Cr. 3. Alt. W, offered 1973.
Prerequisite: Math. 322.
Cartesian tensors; the second order tensor, principal values and Cayley-Hamilton theorem; isotropic tensors, tensor fields, and orthogonal curvilinear coordinates; the stress tensor, simple kinematics, and conservation laws leading to constitutive laws for elasticity and fluid mechanics.

631. CONTINUUM MECHANICS II.
(3-0) Cr. 3. Alt. S, offered 1973.
Prerequisite: 630.
General tensors; curvilinear coordinate systems; kinematics, nonlinear elasticity, non-Newtonian fluids; objectivity, representation theorems, introduction to hypoelastic and viscoelastic materials.

635. RHEOLOGY.
(3-0) Cr. 3. Alt. W, offered 1973.
Prerequisite: 631.
Finite deformations; large strains, Green's right and left strain tensors. Elastic and hyperelastic materials, strain energy function, applications. Inverse methods of solution. Small strain superimposed on large initial strains. Introduction to hypoelasticity, finite viscoelasticity, and elastic fluids.

636. ADVANCED TOPICS IN RHEOLOGY.
(3-0) Cr. 3. Alt. S, offered 1973.
Prerequisite: 635.
Resume of group-invariant formulation, simple materials, polar materials, directors, and materials with memory. Thermodynamics. Further study of special topics of current interest.

Prerequisite: 571: 378 or M.E. 424; 572: 571; 573: 571.
571: Fundamental relationships of fluid dynamics; real and ideal fluids; laminar and turbulent flow; flow in closed conduits and open channels; boundary layer theory; laminar flow, engineering applications. 572: Two- and three-dimensional potential flow problems; application of complex variables to two-dimensional fluid flow; conformal mapping; flow around solid bodies; free streamline theory. Applications to engineering problems. 573: Exact and approximate solutions to Navier-Stokes equations for one- and two-dimensional laminar flow problems, both steady and unsteady flows; exact and approximate solutions to one- and two-dimensional boundary layers; introduction to turbulent boundary layers.

590. SPECIAL TOPICS.
Cr. 2 to 5 each time taken.

593, 594, 595. THEORY OF ELASTICITY.
Prerequisite: 593: 324 or 325; 594: 593; 595: 594, credit or classification in Math. 411.
Fundamental relations of elasticity; uniform and nonuniform states of stress; Airy's function; application to engineering problems.

650. FLUID MECHANICS SEMINAR.
(M.E. 650, Aer.E. 550)
(1-0 to 3-0) Cr. 1 to 3 each time taken.
Prerequisite: Permission of Instructor.
Special topics of current research interest to students and staff of departments concerned.

651, 652, 653. ADVANCED THEORETICAL ASPECTS OF FLUID MECHANICS.
(3-0) Cr. 3 each. Alt. Yr, offered 1972-73.
Prerequisite: 651: 571; 652: 573; 653: 573.
651: Compressible flow: General considerations, theory of characteristics, shocks, detonation and deflagration waves, shock structure, similar solutions. 652: Viscous flow: Asymptotic methods in low and high Reynolds number flows, linear and nonlinear stability. 653: Turbulence: Isotropic turbulence, shear flows, jets and wakes, other recent theories.

655. NONLINEAR WAVE PROPAGATION.
(3-0) Cr. 3. Alt. W, offered 1972.
Prerequisite: 555.
Geometry of moving surfaces: Hadamard's lemma, compatibility conditions; simple waves; ray theory; growth of waves of finite amplitude in continua; nonlinear dispersion.

658. INTRODUCTION TO ELASTIC SHELL THEORY.
(3-0) Cr. 3. Alt. S, offered 1972.
Prerequisite: 586.
Elementary differential geometry of surfaces. Deformation of thin shells.

688. PLASTICITY II.
(3-0) Cr. 3. Alt. S, offered 1973.
Prerequisite: 688.
Elastic-plastic torsion of cylindrical or prismatic bars, combined stresses. Lower bound and upper bound theorems of limit analysis. Extremum principles of Von Mises and Prandtl-Ruess. Discussion of current literature.

699. RESEARCH.
ENGINEERING SCIENCE

Glenn Murphy, Ph.D., Head of Nuclear Engineering

Associate Professor: Paul W. Barcus, Ph.D.

Assistant Professors: Vishvanath D. Chitnis, Ph.D.; Raymond T. Greer, Ph.D.; William D. Leech, Ph.D.; Michael R. Ringham, Ph.D.

Undergraduate Study

For undergraduate curriculum in engineering science leading to the degree Bachelor of Science, see College of Engineering, Curricula.

The curriculum in engineering science is designed particularly for those students who wish to receive comprehensive training in the fundamental principles and concepts of engineering rather than specialize in one particular field. The core of the program, which is based on a background in chemistry, mathematics, and physics, consists of mechanics of solids, mechanics of fluids, nature and properties of materials, electrical theory, thermodynamics, and rate processes. A sequence in analysis and design in the senior year serves to integrate the entire program in engineering science.

The curriculum is well adapted as a base for those students intending to pursue a graduate program in one of the engineering sciences or in nuclear engineering, or who wish to enter the research, development, or design areas of engineering.

The curriculum in engineering science is administered in the Department of Nuclear Engineering.

Graduate Study

Minor work is available to students taking major work in other departments.

Open to graduate students for minor graduate credit only: 351, 352, 353, 481, 482, 483, 484, 490, 491.

COURSES PRIMARILY FOR UNDERGRADUATE STUDENTS

100. TECHNICAL LECTURE.
   (1-0) Cr: R; 8.

211, 212. ENERGY SOURCES AND UTILIZATION.
   (3-0) Cr. 3 each. W.S.
   Prerequisite: 211: Math. 112, Phys. 222; 212: 211.
   Sources of energy, methods of utilization and transformation.

351. ENGINEERING MATERIALS.
   (3-2) Cr. 4. W.
   Prerequisite: Credit or classification in E.M. 325.
   Resistance of materials to failure, definitions and evaluation of properties, relationship to design. Effects of environment on properties. Laboratory determinations.

352. ENGINEERING MATERIALS.
   (3-2) Cr. 4. S.
   Prerequisite: 351 or E.M. 354.
   Structure of materials, and influence of structure upon properties. Properties of single crystals. Interatomic forces, energy considerations.

353. ENGINEERING MATERIALS.
   (3-2) Cr. 4. F.
   Prerequisite: 352.
   Thermal and electrical characteristics, poly-crystalline systems, aggregates of domains. Engineering applications.

401, 402, 403. SEMINAR.
   (1-0) Cr: R; F.W.S.
   Prerequisite: Senior classification.

481, 482, 483. ENGINEERING ANALYSIS.
   (3-2) Cr. 4 each. F.W.S.
   Prerequisite: Chem. 321, E.M. 325, 345.
   Application of the engineering sciences to the analysis of components and systems.

484. PRINCIPLES OF SIMILITUDE.
   (3-2) Cr. 4. F.
   Prerequisite: E.M. 325.
   Dimensional analysis. Principles governing the design and operation of models for the solution of engineering problems. Analogies.

490. SPECIAL PROBLEMS.
   Cr. 2 to 5.
   Prerequisite: Permission of department head.
   Investigation of an approved problem commensurate with the training, interest and ability of the student.
   H. Honors.

491. ENGINEERING DESIGN.
   (1-6) Cr. 4. S.
   Prerequisite: Credit or classification in 483.
   Design problems in engineering science.
ENGLISH

Albert L. Walker, Ph.D., Chairman of Department


Associate Professors: Phillips G. Davies, Ph.D.; Elizabeth G. Fuller, A.M.; Richard C. Gustafson, Ph.D.; Frank E. Haggard, Ph.D.; Quentin G. Johnson, Ph.D.; Hazel E. Lipa, M.A.; John F. Speer, Ph.D.; Richard J. Zbaracki, Ph.D.


Undergraduate Study

For the undergraduate curriculum in sciences and humanities, major in English, leading to the degree Bachelor of Arts or Bachelor of Science, see Sciences and Humanities, Curriculum.

Programs leading to the two degrees for majors in English are flexible, and will vary in accordance with the professional and educational objectives of the student. Students can prepare to teach English in the secondary schools. For the University statement of requirements for teacher certification, see College of Education. Students can prepare for graduate study and eventual teaching in a college or university. They can also prepare for positions in technical writing; advertising, sales, and public relations; personnel; and other phases of business. Students can also pursue premedical, prelegal, or pretheological studies.

Basic instruction in the department is designed to establish proficiency in communication and comprehension necessary for successful college work and requisite to the demands of later personal, professional, and civic life. English 104 and 105 (or 131 and 132) are required of all undergraduates. English 201 is prerequisite for most other courses in literature. Advanced instruction in composition, language, and literature is designed to maintain and increase proficiency and knowledge in these areas.

The department conducts a writing clinic for sophomores, juniors, seniors, and graduate students who wish to improve their written English. The department also conducts a laboratory in developmental reading to meet the needs of students who wish to increase their proficiency beyond the average level. (See English 200.)

A major in English is expected to include the following courses: 363A, 364A, 374A, 375A, 376A, 464A. In addition, one from each of the following groups: 419 or 420; 330, 367, 384A, 384B, or 388; 354A, 354B, or 368; 204, 304A, 304B, 306A, 306B, 315, or 414. Two college years, or equivalent, of a single foreign language are required. These listings should not be regarded as complete outlines of necessary or desirable courses. Students will plan their complete programs according to individual needs, with the help of their advisers.
Graduate Study

The department offers work for the degree Master of Arts with major in English and minor work for students majoring in other departments. The master's degree ordinarily requires a thesis (6 credits); only in rare instances are non-thesis programs approved. Credits must include 530; 511 or 512; and usually 503. A reading knowledge of one foreign language is required, to be demonstrated by test or by course work at an advanced undergraduate level. Near the end of the program, candidates will be examined, in writing, on a number of literary works they have selected from a reading list and read independently.

Prerequisite to major graduate work is the completion of study substantially equivalent to the undergraduate major program in English at this institution.

Programs are designed to prepare students for: (1) further graduate study in language and literature, (2) teaching at the secondary, junior college, or beginning university level, (3) imaginative writing, scientific and technical writing, and editing.

In addition to the usual areas of study in literature and language, these special emphases are provided: (1) rhetorical, linguistic, and semantic analysis of factual and imaginative writing and of literary criticism; (2) scientific and technical writing; (3) study of the relations between science and imaginative literature and criticism.


COURSES PRIMARILY FOR UNDERGRADUATE STUDENTS

10A, 10B, 10C. ENGLISH FOR FOREIGN STUDENTS.

10A: (6-2); 10B: (4-1); 10C: (3-0).

Prerequisite: Recommendation of English Department. Placement in the various classes is determined by examination.


104, 105. LANGUAGE IN COMPOSITION AND READING.

(4-0) Cr. 4 each. F.W.S.SS.

Prerequisite: 104: 104.

The role of language in human thought. Applications to reading and writing. Writing as communication of developed judgment or observation. Readings in expository and imaginative literature. Emphasis on reading and observation as sources of information, ideas, and values.

131, 132. PRINCIPLES OF COMPOSITION.

(3-0) 131: Cr. 5. F; 132: Cr. 5. W.

Prerequisite: Selection of students solely by the Department of English on the basis of high school preparation and competence displayed in examinations. Application of principles governing the use of language in writing and reading. A course designed for especially advanced students as an alternate to 104, 105. Satisfies 104, 105 requirement in all curricula.

200. DEVELOPMENTAL READING.

(0-2) Cr. 1 each time taken, maximum 3 credits. Satisfactory-fail basis only. F.W.S.SS.

Acceptable only for elective credit in Sciences and Humanities. Training in reading proficiency through improvement of comprehension and cultivation of motor skills and habits conducive to increased reading speed. Emphasis on vocabulary development.

201. INTRODUCTION TO LITERATURE.

(3-0) Cr. 3. F.W.S.SS.

Prerequisite: Credit or classification in 105. Introduction to the functions of imaginative literature. Emphasis on comprehension of both older and more recent literary types. Literature in its relation to recurrent human problems; foundations for more advanced study.

204. INTERMEDIATE COMPOSITION.

(3-0) Cr. 3. F.W.S.

Prerequisite: 105.

Expository writing: practice in writing and criticizing exposition. Concepts of grammar and rhetoric where pertinent to analysis of writing.

205. PROPAGANDA ANALYSIS: REASONING AND WRITING.

(3-0) Cr. 3. F.W.S.SSII.

Prerequisite: 105.

Study of the language in which current issues are presented to the public, especially language which may arouse feeling or confuse thought. Application of basic rules of thinking to issues studied; practice in informative and persuasive writing; reading and discussion.

304A, 304B. ADVANCED COMPOSITION.

(3-0) Cr. 3 each. F.W.S.

Prerequisite: 105, junior or senior classification, permission of instructor.

304A: Descriptive and narrative techniques; emphasis on characterization and the short story. Writing, reading, criticism. 304B: Personalized exposition; personal, social, or scientific material with individualized expression.

306A, 306B. ADVANCED COMPOSITION.

Cr. 3 each time taken, but not normally repeated. F.W.S.

Prerequisite: 304A or 304B, permission of instructor.


315. SCRIPT WRITING FOR TELEVISION, FILM, AND RADIO.

(3-0) Cr. 3. W.

Prerequisite: 304.

Techniques of writing for television, film, and radio. Selected scripts used in broadcasts on WOIR.
330. **MODERN LITERATURE.**
(3-0) Cr. 3. W.S.SSII.
Prerequisite: 201.
Reading, interpretation, and evaluation of prose, fiction, drama, and poetry of representative American and British authors of the twentieth century.

344. **READINGS IN BIOGRAPHY.**
(3-0) Cr. 3. S.
Prerequisite: 105.
Selections from biography and autobiography of great creative workers in science, engineering, agriculture, the arts, government. Other eminent contributors to civilization. Special attention to lives of scientists and to procedures of science. Impact of great men upon their own and later times.

354A, 354B. **WORLD LITERATURE.**
(3-0) Cr. 3 each. 354A: W.S.SSII; 354B: S.SSII.
Prerequisite: 201.
354A: Ancient classics to Renaissance: Greek and Roman literature; European literature of the middle ages; selections from Indian, Chinese, Arabian, and Persian literature. 354B: European literature of Renaissance to 1900. Selected European literature from early Renaissance to modern times.

356. **OLD TESTAMENT.**
(3-0) Cr. 3. S.
Prerequisite: 105.
Literature of Old Testament and apocrypha including narrative, poetry, wisdom literature, and apocalyptic literature.

363A, 363B. **AMERICAN LITERATURE TO 1850.**
(3-0) Cr. 3 each. 363A: F.W.S.SSI; 363B: Alt. S. offered 1972.
Prerequisite: 383A: 201; 363B: 363A.
363A: Selected American masterpieces to 1850, their literary value and their significance as expressions of varying attitudes toward the individual and society. 363B: Literature of Colonial America. Significant American literary figures from 1600 to 1800.

364A, 364B. **AMERICAN LITERATURE, 1850-1900.**
(3-0) Cr. 3 each. 364A: F.W.S.SSI; 364B: Alt. F. offered 1972.
Prerequisite: 364A: 201; 364B: 364A.
364A: Selected American masterpieces, 1850-1900, with attention to their literary value and their significance as expressions of varying attitudes toward the individual and society. 364B: Realism in American literature. Significant writers and works in the rise of American realism between the Civil War and World War I.

365. **AFRO-AMERICAN LITERATURE.**
(3-0) Cr. 3. W.
Prerequisite: 201, or consent of department chairman.
Literature by black Americans considered against the intellectual and social backgrounds of American life and letters.

366. **EUROPEAN DRAMA: THE GREEKS TO IBSEN.**
(3-0) Cr. 3. W.
Prerequisite: 201.
Aeschylus to Ibsen, exclusive of British drama.

367. **EUROPEAN AND AMERICAN DRAMA SINCE IBSEN.**
(3-0) Cr. 3. S.
Prerequisite: 201.
Significant trends in drama from Ibsen through World War II.

368. **BRITISH DRAMA TO 1642 EXCLUSIVE OF SHAKESPEARE.**
(3-0) Cr. 3. Alt. W. offered 1972.
Prerequisite: 201.
Medieval, Elizabethan, and Jacobean drama; reading, discussion, and criticism of representative plays.

374A, 374B. **ENGLISH LITERATURE.**
Prerequisite: 374A: 201; 374B: 374A.
374A: Selected British authors and works to 1600. Introduction to early period of English literature. 374B: Chaucer. Reading of The Canterbury Tales in Middle English.

375A, 375B. **ENGLISH LITERATURE.**
(3-0) Cr. 3 each. 375A: W.SSII: 375B: Alt. W. offered 1972.
Prerequisite: 375A: 201; 375B: 375A.
375A: Selected British authors, 1600-1800. 375B: Milton and his contemporaries. Selected poetry and prose of Milton and his contemporaries, with emphasis on the poetry of Milton, Marvell, and Dryden.

376A, 376B. **ENGLISH LITERATURE.**
(3-0) Cr. 3 each. 376A: F.S; 376B: Alt. S. offered 1973.
Prerequisite: 376A: 201; 376B: 376A.
376A: Selected British authors, 1800-1900. Introduction to English literature of the Romantic and Victorian periods.
376B: The Romantic Movement, Blake, Burns, and minor precursors of romanticism; Wordsworth, Coleridge, Scott, Byron, Shelley, Keats, Lamb, Hazlitt, DeQuincey.

384A, 384B. **MODERN FICTION.**
(3-0) Cr. 3 each. 384A: F.S.SSII; 384B: S.
Prerequisite: 201.

388. **MODERN POETRY.**
(3-0) Cr. 3. F.
Prerequisite: 201.
Reading of representative work of significant American and British poets of the twentieth century; interpretation of the poems as the communication of personal and social values.

392A, 392B. **THE ENGLISH NOVEL TO 1900.**
Prerequisite: 201.
392A: Development of the English novel to 1832. 392B: The Victorian novel.

404. **BUSINESS COMMUNICATION.**
(2-0) Cr. 2. F.W.B.
Prerequisite: 105, junior classification.
Principles which govern business communications. Problem approach to various types of letters. Current methods and media in business communication.

414. **WRITING OF REPORTS AND TECHNICAL PAPERS.**
(3-0) Cr. 3. F.W.S.SS.
Prerequisite: 108; junior, senior, or graduate classification.
Technical, research, and business report writing. Principles of technical exposition. Writing of reports, preferably on topics from the student's own discipline. (For advanced projects see Engl. 507.)

419. **MODERN GRAMMAR.**
(3-0) Cr. 3. F.W.SSII.
Prerequisite: 105.
Modern grammar and linguistics; methods of grammatical analysis.
420. DEVELOPMENT OF THE ENGLISH LANGUAGE.
(3-0) Cr. 3. S. 
Prerequisite: 105, junior classification.
Background and development of the English language; its relationships with other languages of the past and present, modern English grammar; contemporary developments in the language.

450. LITERARY CRITICISM.
(3-0) Cr. 3. S. 
Prerequisite: 354A, 464A.
The nature of criticism; ideas and attitudes of critics from early times to the present, relationships between literature and psychology. Literary scholarship as related to criticism. The book review as a critical form.

464A, 464B. SHAKESPEARE.
(3-0) Cr. 3 each. 464A: F.S.; 464B: W. 
Prerequisite: 464A: 201; 464B: 464A.
464A: Introduction to Shakespeare’s dramatic art. Selected comedies, histories, and tragedies, with emphasis on the understanding of character. 464B: Shakespeare’s development as a dramatist. Intensive study of selected plays, with emphasis on Shakespeare’s development as a playwright; background of the period. Introduction to Shakespeare scholarship.

476. VICTORIAN POETRY.
(3-0) Cr. 3. Alt. F, offered 1972. 
Prerequisite: 376A.
Selected Victorian poets with attention to later and transitional figures. Aspects of the Victorian age reflected in the poetry.

477. VICTORIAN PROSE.
(3-0) Cr. 3. Alt. W, offered 1973. 
Prerequisite: 376A.
Selected Victorian prose. Aspects of the Victorian age reflected in the prose.

503. PROBLEMS IN WRITTEN COMMUNICATION.
(3-0) Cr. 3. W SSII. 
Prerequisite: Permission of instructor.

504. ADVANCED IMAGINATIVE WRITING.
(3-0) Cr. 1 to 3 each time taken, maximum of 9. F.W SSII. 
Prerequisite: 304A or B, permission of instructor one quarter before course begins.
Individual projects.

507. SCIENTIFIC AND TECHNICAL WRITING.
Cr. 1 to 3 each time taken, maximum of 6. F.W SSII. 
Prerequisite: Permission of instructor one quarter before course begins.
Technical language and style. Analysis and writing of scientific prose, including abstracts, manuals, proposals, and other technical papers. Individual projects. Directed readings.

511. INTRODUCTION TO GENERAL LINGUISTICS.
(3-0) Cr. 3. W Alt. SSII, offered 1973. 
Prerequisite: Permission of instructor.
Principles of general linguistics; history of the development of modern linguistic science.

509. UNDERGRADUATE SEMINAR.
(3-0) Cr. 1 to 3 each time taken, maximum of 6 credits. F.W S. 
Prerequisite: Twelve credits in English beyond 105.
Intensive study of a selected topic in literature, criticism, or language.

512. PROBLEMS IN THE HISTORY OF THE ENGLISH LANGUAGE.
(3-0) Cr. 3. S. Alt. SSII, offered 1972. 
Prerequisite: Permission of instructor.
Historical linguistics; application to selected problems in the development of the English language.

522. THEORY OF LITERATURE.
(3-0) Cr. 3. S. Alt. SSII, offered 1973. 
Prerequisite: Nine credits in literature beyond 201.
Application of critical principles to literary problems and controversies. Clarification of terminology; examination of critical generalizations and assumptions.

523. EXPERIMENTAL DRAMA.
Prerequisite: Nine credits in drama.
Significant trends in British, American, and Continental drama since World War II.

530. BIBLIOGRAPHY AND RESEARCH METHODS.
(3-0) Cr. 3. F SSII. 
Prerequisite: Eighteen credits in literature.
Required of candidates for the master’s degree.

532. MODERN SATIRE.
Prerequisite: Nine credits in American, British, or world literature.
Satire since World War I.
534. SCIENCE AND LITERARY IMAGINATION. (3-0) Cr. 3 each time taken, maximum of 9. Alt. F, offered 1971.
Prerequisite: Nine credits in British or American literature.
Imaginative literature and criticism from a selected historical period, considered with reference to concurrent developments in science. Emphasis on literary world picture, metaphor, and language theory.

562. AMERICAN TRANSCENDENTALIST WRITERS. (3-0) Cr. 3. S. Alt. SSII, offered 1973.
Prerequisite: Nine credits in American literature including 363A.
Transcendentalism as a force in American literature, with main emphasis on philosophic origins, the American scene, and the writings of Emerson, Thoreau, and the minor transcendentalists.

563. THE AMERICAN NOVEL. (3-0) Cr. 3 each time taken, maximum of 6. F. SSII.
Prerequisite: Nine credits in American literature including 364A.
Major developments in the American novel to 1900.

564. SIGNIFICANT AMERICAN NONFICTION. (3-0) Cr. 3. Alt. W. and SSII, offered 1972.
Prerequisite: Nine credits in American literature including 364A.
Idealism, realism, and skepticism since the 1840's, as reflected by essayists of distinction such as Emerson, Thoreau, Twain, William James, Henry Adams, Veblen, Santayana, Bourne, Mencken, E. B. White, and others.

566. MAJOR AMERICAN POETS. (3-0) Cr. 3 each time taken, maximum of 6. W. Alt. SSII, offered 1973.
Prerequisite: Nine credits in American literature including 364A.
Major American poets from Edward Taylor through Eliot and Frost, but with particular emphasis on such nineteenth century figures as Bryant, Emerson, Whitman, Dickinson, and Melville.

Prerequisite: Nine credits in English literature including 375A.
Development of English poetry from Donne to Dryden. Concentration on a few selected authors, excluding Milton.

Prerequisite: Nine credits in English literature including 375A.
Selected neoclassic writers in verse and prose: Dryden, Addison, Pope, Johnson, and their circles.

Prerequisite: Nine credits in English literature including 374A.
Poetry and prose of the sixteenth and early seventeenth centuries.

574. CHAUCER. (3-0) Cr. 3. F. Alt. SSII, offered 1972.
Prerequisite: Nine credits in English literature including 374A.
Intensive study of selected Canterbury Tales and minor poems. Introduction to Chaucer scholarship.

575. MILTON. (3-0) Cr. 3. S. Alt. SSII, offered 1972.
Prerequisite: Nine credits in English literature including 375A.
Paradise Lost, with other poems and selections from the prose.

576. ROMANTIC WRITERS. (3-0) Cr. 3 each time taken, maximum of 6. Alt. F. Alt. SSII, offered 1972.
Prerequisite: Nine credits in English literature including 376A.
Wordsworth, Coleridge, and selected minor contemporaries. Byron, Shelley, and Keats and selected minor contemporaries.

Prerequisite: Nine credits in English literature including 376A.
Selected Victorian and Edwardian authors.

Prerequisite: Nine credits in English literature including 376A.
Restoration and 18th-century comedy, and heroic tragedy, as seen in the plays of Dryden, Wycherley, Congreve, and minor dramatists.

580. SHAKESPEARE. (3-0) Cr. 3. W. SSII.
Prerequisite: Nine credits in English literature including 464B.
Shakespeare as poet and dramatist. Chief critical schools and areas of scholarship.

589. SEMINAR. Cr. var.
Prerequisite: Permission of Instructor.
A. Individual authors.
B. Literary periods and movements; history of ideas.
C. Genres.
D. Theory and criticism.
E. Language and linguistics; semantics.

590. SPECIAL TOPICS. Cr. var.
Prerequisite: Permission of department chairman.
A. Linguistics; semantics.
B. Literature; criticism.
C. Rhetorical analysis; communication.

COURSES FOR GRADUATE STUDENTS, major or minor

689. GRADUATE SEMINAR. Cr. var. F.W.S.S.
Prerequisite: Eighteen graduate credits, permission of department chairman.

699. RESEARCH.
ENTOMOLOGY

For description of courses, see Zoology and Entomology

FAMILY ENVIRONMENT

Ronald C. Powers, Ph.D., Head of Department

Professors: Elizabeth Beveridge, M.S.; Marie A. Budolfson, M.S.; Margaret I. Liston, Ph.D.; Louise J. Peet, Ph.D.; Mary S. Pickett, Ph.D.

Associate Professors: Elmer Schwieder, Ph.D.; Naomi D. Shank, B.S.; Helen Wells, Ph.D.

Assistant Professors: Mary Heltsley, Ph.D.; Alice Petersen, Ph D.; Frankie N. Schwenk, M.S.; David Weltha, Ph.D.

Instructors: Mary deBaca, M.S.; Evelyn Eldridge, M.S.; Karen B. Hull, M.S.; Dorothy H. Martin, M.S.; Nancy Meredith, M.S.; Joanne Wiksell, M.S.

Undergraduate Study

For undergraduate curriculum in family environment leading to the degree of Bachelor of Science, see Home Economics, Curricula.

The department offers work for the degree Bachelor of Science with a major in family environment.

The Department of Family Environment offers courses designed to develop an understanding of the family as and in environment. Students may orient their program to one of the following: helping services; consumer services in areas of housing, equipment, management, and family; community services or general education. Examples of opportunities in the helping services include social welfare, family service agencies, and public housing. Consumer service opportunities exist in business and industry, government agencies, and private nonprofit organizations. Community services include home economics extension and field staff for various youth groups. The emphasis in general education is nonprofessionally oriented.

Graduate Study

The department offers work for the degree Master of Science with major in family environment and minor work for students taking major work in other departments. Work may be taken for the degree Doctor of Philosophy as a joint major with departments such as Home Economics Education, Child Development, Food and Nutrition, Economics, Physics, Chemistry, and Sociology and Anthropology. The department cooperates in both the water resources program and the housing program. See Water Resources and Housing.

Prerequisite to major work in family environment is the completion of at least 15 credits in each of the following areas: communicative arts, humanities, physical and biological sciences, and social and behavioral sciences. The student should also have the equivalent of the courses generally considered as introductory principles in the family environment program at this institution. Students emphasizing the physical aspects of family environment should have the basic work in equipment and food preparation. Educational background in the biological, chemical, physical, or social sciences may be suitable, depending on the student's objectives.

There is no stipulated foreign language requirement for graduate study. All requirements
are the responsibility of the student's program of study committee, subject to approval of the department head.

Open to graduate students for minor graduate credit only: 308, 340, 408, 410, 412, 415, 445, 446, 470, 485, 488, 489.

**COURSES PRIMARILY FOR UNDERGRADUATE STUDENTS**

185. FAMILIES AND THEIR ENVIRONMENT.
   (3-0) Cr. 3. F.W.
   Exploration of the social, economic, physical, and aesthetic dimensions of family environment.

240. INTRODUCTION TO FAMILY HOUSING.
   (3-0) Cr. 3. F.W.S.
   Criteria for evaluating aspects of family housing environment in the United States. Factors related to differences in housing needs. Problems and programs for housing improvement.

254. EQUIPMENT IN THE HOME.
   (3-0) Cr. 3. F.W.S.
   Utilization of water, electricity, gas, light, and heat for doing work and maintaining health and comfort in the home environment. Application of basic physical science principles.

270. THE INDIVIDUAL AND HIS FAMILY.
   (3-0) Cr. 3. F.W.S.SS. Satisfactory-fail only.
   Prerequisite: Three credits of psychology, Soc. 134.
   Basic need fulfillment throughout the life cycle. Developing individual potential as a member of a family through experiences of love, trust, identity, responsibility, and autonomy.

285. FAMILY NEEDS AND SERVICES IN AMERICAN CULTURE.
   (3-0) Cr. 3. F.W.S.
   Prerequisite: Three credits of psychology, Soc. 134.
   Examination of needs and services within stages of family development and among families of different socio-economic levels. Particular emphasis upon the evolution of familial needs and services.

308. MODERN LIGHTING FOR RESIDENTIAL INTERIORS.
   (2-4) Cr. 3. F.W.S.
   Prerequisite: Three credits in housing and equipment, permission of instructor.
   Lighting as a design factor to meet needs of individuals and families for task, general, and decorative purposes. Light sources and techniques to implement objectives in design.

318. SMALL EQUIPMENT.
   (2-4) Cr. 3. F.W.S.
   Prerequisite: Sophomore classification.
   Selection and use of portable appliances as related to various consumer needs and interests. Laboratory experiences with appliances for food preparation, care of the home, clothing construction, personal grooming.

340. HOUSING FOR SPECIAL GROUPS.
   (3-0) Cr. 3. S.
   Prerequisite: 240.
   The housing problems of the low-income, minority, and physically limited segments of our society. Programs and research currently being conducted or proposed toward solution of the housing problems of these groups.

341. HOUSING FINANCE.
   (3-0) Cr. 3. W.
   Prerequisite: 240; Econ. 241 or 242.
   Financial consideration needed when individuals and families rent, remodel, buy, or build dwellings.

375. MANAGEMENT IN THE FAMILY.
   (3-0) Cr. 3. F.W.S.SS.
   Prerequisites: Three credits of psychology, Soc. 134, Econ. 241 or 242.
   Management related to functions of the family in society. Comparison of families with respect to goals sought, resources available, and managerial behavior. Changes within the family and its environment which necessitate management. Decision and choice as aspects of individual and group adjustment to changed situations.

385. FAMILY LIFE PATTERNS.
   (3-0) Cr. 3. F.W.S.
   Prerequisite: Three credits of psychology, Soc. 134.
   Standards and levels of living and life styles. Relationship of environmental conditions to family life patterns.

386. FAMILY SERVICES.
   (3-0) Cr. 3. F.W.
   Prerequisite: 286.
   An examination of organizations and agencies serving families. Emphasis on purposes, staffing, operation, and clientele. Analysis of problems in coordination and delivery of services to families. Role of volunteers and professionals in family services.

408A. 408B. EQUIPMENT FOR CARE OF MODERN FABRICS.
   408A: (3-0) Cr. 3. S. 408B: (0-3) Cr. 1. S.
   Prerequisite: Junior classification.

410. FOOD-RELATED MAJOR HOME APPLIANCES.
   (3-3) Cr. 4. W.
   Prerequisite: 254, F.& N. 208.
   Evaluation of ranges, refrigerators, and food freezers designed for use in homes. New developments and basic characteristics of these appliances affecting their selection and utilization by consumers.

412. KITCHEN, BATH, AND UTILITY AREA PLANNING.
   (2-4) Cr. 3. W.
   Prerequisite: Junior classification.
   Planning of kitchen, bath, and utility areas for form, function, and economy; problems of effective use of utilities; remodeling.

415. CONSUMER BEHAVIOR.
   (3-0) Cr. 3. W.
   Prerequisite: Three credits of psychology, Soc. 134, Econ. 241 or 242.
   Dimensions of consumer behavior; consumer competence; interaction of consumers, government and the marketing system; processes of consumer choice; evaluation of consumer information and protection. Field trip.
COURSES PRIMARILY FOR GRADUATE STUDENTS, major or minor, open to qualified undergraduates

500. FAMILY ENVIRONMENT SHORT COURSES. Cr. arr. S.
Short courses designed primarily for special groups. Credits are not accepted for graduate credit in family environment. Short courses are offered under the following general designations.
A. Family Relations and Human Development.
B. Housing.
C. Consumer Economics and Management.
D. Household Equipment.
E. General Family Environment.

504. RESEARCH METHODS AND TECHNIQUES. (2-4) Cr. 4. F.
Research methods and techniques applicable to studies of the family as an environment. Emphasis on research design and problem selection.

519. CONSUMER DYNAMICS. (3-0) Cr. 3. S.
Prerequisite: 415, 488.
Consumer roles in the evolution of economic society. Analysis of changes in consumer interactions with public and private institutions serving consumer interests.

521. HOUSING AND SOCIAL ENVIRONMENT. (3-0) Cr. 3. S.
Prerequisite: 240 or equivalent, Econ. 241 or 242, three credits of psychology, Soc. 134.
Study of housing as related to social environments: political, economic, and sociological. Management of housing for human development. Emphasis on research.

522. TIME AND HUMAN RESOURCES. (3-0) Cr. 3. W.

485. PLANNING CHANGE IN THE FAMILY ENVIRONMENT. (3-0) Cr. 3. S.
Prerequisite: Junior classification or permission of the instructor.
Methods of identifying and analyzing problems in the environment of families. Techniques of involving families in effective processes of planning change.

488. FAMILY FINANCE. (3-0) Cr. 3. F.W.S.S.S.
Prerequisite: Three credits of psychology, Soc. 134, Econ. 241 or 242.
Managerial approaches to financial problems of families. Decision making relative to acquiring and allocating income. Financial management focused on consumer credit, savings and investment, insurance, home ownership, and estate planning.

489. MANAGERIAL RESOURCES AND PROCESSES IN FAMILY LIFE. (2-3) Cr. 3. F.S.
Prerequisite: 375.
Processes involved in management of family resources of human capital, property, and community opportunities, as well as money, time, space, and natural environment.

490. SPECIAL PROBLEMS. Cr. arr.
Prerequisite: Twelve credits in family environment, permission of instructor.
A. Family Relations and Human Development.
B. Housing.
C. Consumer Economics and Management.
D. Household Equipment.
E. Field Trips and Field Experience.
F. General Family Environment.
G. Honors Program.

500. FAMILY ENVIRONMENT SHORT COURSES. Cr. arr. S.
Short courses designed primarily for special groups. Credits are not accepted for graduate credit in family environment. Short courses are offered under the following general designations.
A. Family Relations and Human Development.
B. Housing.
C. Consumer Economics and Management.
D. Household Equipment.
E. General Family Environment.

504. RESEARCH METHODS AND TECHNIQUES. (2-4) Cr. 4. F.
Research methods and techniques applicable to studies of the family as an environment. Emphasis on research design and problem selection.

519. CONSUMER DYNAMICS. (3-0) Cr. 3. S.
Prerequisite: 415, 488.
Consumer roles in the evolution of economic society. Analysis of changes in consumer interactions with public and private institutions serving consumer interests.

521. HOUSING AND SOCIAL ENVIRONMENT. (3-0) Cr. 3. S.
Prerequisite: 240 or equivalent, Econ. 241 or 242, three credits of psychology, Soc. 134.
Study of housing as related to social environments: political, economic, and sociological. Management of housing for human development. Emphasis on research.

522. TIME AND HUMAN RESOURCES. (3-0) Cr. 3. W.

485. PLANNING CHANGE IN THE FAMILY ENVIRONMENT. (3-0) Cr. 3. S.
Prerequisite: Junior classification or permission of the instructor.
Methods of identifying and analyzing problems in the environment of families. Techniques of involving families in effective processes of planning change.

488. FAMILY FINANCE. (3-0) Cr. 3. F.W.S.S.S.
Prerequisite: Three credits of psychology, Soc. 134, Econ. 241 or 242.
Managerial approaches to financial problems of families. Decision making relative to acquiring and allocating income. Financial management focused on consumer credit, savings and investment, insurance, home ownership, and estate planning.

489. MANAGERIAL RESOURCES AND PROCESSES IN FAMILY LIFE. (2-3) Cr. 3. F.S.
Prerequisite: 375.
Processes involved in management of family resources of human capital, property, and community opportunities, as well as money, time, space, and natural environment.

490. SPECIAL PROBLEMS. Cr. arr.
Prerequisite: Twelve credits in family environment, permission of instructor.
A. Family Relations and Human Development.
B. Housing.
C. Consumer Economics and Management.
D. Household Equipment.
E. Field Trips and Field Experience.
F. General Family Environment.
G. Honors Program.
575. CULTURAL FOUNDATIONS OF FAMILY LIFE.  
(3-0) Cr. 3. F.  
Prerequisite: Nine credits in behavioral sciences.  
Cultural influences in individual and family development; roles of family members; values, customs, taboos, and rituals related to family life.

579. DYNAMICS OF FAMILY RELATIONSHIPS.  
(3-0) Cr. 3. S.  
Prerequisite: Nine credits in psychology.  
Theories of family relations and individual development. Emphasis on the development of healthy, full-functioning individuals and the family environment that contributes to this development.

588. FAMILY ECONOMICS.  
(3-0) Cr. 3. F.  
Prerequisite: Econ. 241 or 242; 3 credits in psychology, Soc. 134.  
Problems of measuring family income, wealth, and welfare. Programs for improving adequacy and security of income during family life cycle. Factors which influence standards and levels of living.

590. SPECIAL TOPICS.  
Cr. arr.  
Prerequisite: Permission of instructor.  
A. Family Relations and Human Development.  
B. Housing.  
C. Consumer Economics and Management.  
D. Household Equipment.  
F. Field Trips and Field Experience.  
G. General Family Environment.

591. PRACTICUM IN FAMILY ENVIRONMENT.  
(as arr.) Cr. 1 to 6 each time elected.  
Prerequisite: Completion of 15 credits of graduate coursework.  
Supervised experience in the following areas of family environment.  
A. Family Relations and Human Development.  
B. Housing.  
C. Consumer Economics and Management.  
D. Household Equipment.  
G. General Family Environment.

COURSES FOR GRADUATE STUDENTS, major or minor

604. SEMINAR.  
Cr. 1 to 3. F.W.S.  
A. Family Relations and Human Development.  
B. Housing.  
C. Consumer Economics and Management.  
D. Household Equipment.  
G. General Family Environment.

699. RESEARCH.  
Cr. arr.  
A. Family Relations and Human Development.  
B. Housing.  
C. Consumer Economics and Management.  
D. Household Equipment.  
G. General Family Environment.

FARM OPERATION

For more information about this curriculum, see College of Agriculture, Curricula

FISHERIES and WILDLIFE BIOLOGY

For description of courses, see Zoology and Entomology

FOOD AND NUTRITION

Wilma D. Brewer, Ph.D., Head of Department

Professors: Lotte Arnrich, Ph.D.; Mary Agnes Frances Carlin, Ph.D.; Ercel S. Eppright, Ph.D.; Thelma J. McMillan, Ph.D.; E. Madge Miller, Ph.D.; Charlotte Roderuck, Ph.D.; Pearl Swanson, Ph.D. (Emeritus)

Associate Professors: Pilar Garcia, Ph.D.; Mary Alice Kenney, Ph.D.; Phyllis Olson, M.S.; Nelle E. Thompson, M.A.

Assistant Professors: Barbara K. Lunde, Ph.D.; Pauline Mairs, M.S.; Diane McComber, M.S.; Thora J. Runyan, Ph.D.; William S. Runyan, Ph.D.

Instructors: Jeannette Bohnenkamp, M.S.; E. Carol Dierks, M.S.; Jane Judge, M.S.; Mary J. Oakland, M.S.; Ruth Smith, B.S.; Judith Stang, B.S.; Barbara S. Stoecker, Ph.D.
Undergraduate Study

Courses in food and nutrition acquaint the student with the principles underlying the selection, preparation, and use of food for human health and for the welfare of society. Emphasis is placed on the scientific, cultural, and professional aspects of the broad area of food and nutrition.

The department offers work for the degree Bachelor of Science with four majors: community nutrition, dietetics, food and nutrition and related science, and food science. Each of these majors affords excellent preparation for many different kinds of positions and provides a good basis for graduate study for students who wish to continue for advanced degrees.

The major in community nutrition offers preparation for work as a nutrition consultant in public health, social welfare organizations, extension service, or industry. This major is planned for students interested in helping people everywhere to use knowledge of nutrition for the betterment of their health.

The major in dietetics is planned for students interested in food service and nutrition education. Graduates are prepared for a wide variety of positions in hospitals, clinics, sanatoriums, and homes for children and for the aged. They may work as private nutrition consultants in cooperation with physicians, or as nutritionists with food industries. This major includes the academic requirements of the American Dietetic Association.

The major in food and nutrition and related science prepares students for positions as research assistants in laboratories of colleges and universities, research institutes, government agencies, industries, and foundations. It affords an especially strong background for graduate work.

The major in food science serves those who are interested in preparation of food and in food-product development in experimental kitchens or laboratories of industries or universities. It prepares students for food-product development or food-promotion programs in industries, for food editorships in papers and magazines, and for conducting food-centered programs on radio and television. It leads to careers in consumer services in business and industry.

Graduate Study

The department offers work for the degree Master of Science with majors in food science, nutrition, and food and nutrition, and for the degree Doctor of Philosophy with majors in food science and nutrition, and minor work for students majoring in other departments.

Prerequisite to major work is the completion of a curriculum in food and nutrition substantially equivalent to that required of undergraduates at Iowa State University. Students with undergraduate majors in biological and physical sciences are qualified for graduate study in food science and nutrition.

Students taking major work for the degree Doctor of Philosophy either in food science or in nutrition may choose minors to further their interests in related areas. Minors may be selected from other fields of home economics as well as from chemistry, biochemistry, bacteriology, economics, food technology, journalism, psychology, physiology, or statistics. There is no foreign language requirement for the degree Master of Science. For the degree Doctor of Philosophy, the foreign language requirement may be met by: (1) demonstration of a satisfactory reading knowledge of two languages (French, German, Spanish, Russian); (2) competence in communication in one of the above languages as demonstrated by examination or as indicated by two years of course work (C grade or better) in the baccalaureate program.

Open to graduate students for minor only: 305, 409, 410, 413, 414.

COURSES PRIMARILY FOR UNDERGRADUATE STUDENTS

107. NUTRITION AND THE FAMILY’S FOOD. (4-0) Cr. 4. P.W.S.S.
Prerequisite: Five credits biological science.
The selection and use of food for health and satisfaction of the individual and the family.

201. ORIENTATION TO FOOD AND NUTRITION. (1-0) Cr. 1. S.S.
Prerequisite: Freshman or sophomore classification.

208. PRINCIPLES OF FOOD PREPARATION. (3-6) Cr. 5. F.W.S.
Prerequisite: 107, credit or classification in Chem. 231 or 334.
Application of scientific principles in the use and preparation of selected food products.
214. 215. FOODS I AND II.  
214: (2-6); 215: (1-6) Cr. 4 each. F.W.S.  
Prerequisite: 214: 107, Chem. 231 or 334; 215: 214.  
Composition and structure of foods and principles underlying preparation of food products of standard quality; behavior and interactions of constituents of food. This sequence is prerequisite for advanced study of food.

232. NUTRITION OF THE CHILD AND THE FAMILY.  
(3-0) Cr. 3. F.W.S.  
Prerequisite: Five credits in biological science. Nutritional needs during reproduction, growth, and later life; adjusting meals to meet the needs of family members. Not available to students with credit in 107, 305 or 410.

290. SPECIAL PROBLEMS.  
Cr. arr.  
Prerequisite: Permission of Instructor.

303. FAMILY MEAL MANAGEMENT.  
(3-3) Cr. 4. F.W.S.SSI.  
Prerequisite: 107 or 305; 208 or 215. Thompson. Choice, purchase, preparation, and service of foods; a study of foods on the market; time, energy, and money management in relation to feeding the family; consideration of nutritional needs, food habits, and social customs of family groups.

305. NUTRITION AND DIETETICS.  
(3-3) Cr. 4. F.W.S.  
Prerequisite: Three credits in biochemistry; Biol. 101 or Zoel. 155, junior classification. McMillan. Physiological and chemical bases for nutrient needs; factors to consider in satisfying these needs for individuals and populations.

320. FUNDAMENTALS OF FOOD MEASUREMENTS.  
(1-6) Cr. 3. S.  
Prerequisite: 215, 303; Phys. 108 or 111. Advance reservation required. Miller. Basic concepts and principles of the assessment of foods; introductory aspects of subjective and objective evaluation of food quality. Certain basic influences in food acceptance patterns.

400. FIELD STUDY TOUR.  
Cr. R; F.S.  
Prerequisite: A: Credit or classification in 409; B: Senior classification, permission of instructor. A: Observation of the dietitian in a medical teaching center, hospital, clinic, and public health department. B: Guided study tour of industrial food centers, food research laboratories, and experimental test kitchens.

404. SEMINAR IN FOOD AND NUTRITION.  
(2-0) Cr. 2. F.W.  
Prerequisite: 305. Senior classification. Majors only. Brewer. Orientation to professional work; state, national, and international problems in food and nutrition.

409. DIET THERAPY.  
(4-0) Cr. 4. F.W.  
Prerequisite: 305. Basic biochemical and physiological conditions which necessitate dietary modification as a part of the therapeutic management of the patient; role of dietitian in hospital and other health services.

410. NUTRITION DURING HUMAN GROWTH AND DEVELOPMENT.  
(2-2) Cr. 3. F.S.  
Prerequisite: 305. Nutritional needs during growth and reproduction; problems in feeding infants, children, and women during the reproductive period; indices of growth and development.

411. EXPERIMENTAL STUDIES OF FOOD.  
(2-6) Cr. 4. F.W.  
Prerequisite: 215, 3 credits in biochemistry, senior classification. Miller. Application of scientific principles to the solution of problems in food preparation. Not to be taken by majors in food science or students desiring to take 421 and 422.

413. COMMUNITY NUTRITION.  
(2-3) Cr. 3. F.  
Prerequisite: 305. Survey of current public health nutrition problems; food misinformation; food habits of population groups which have a high incidence of malnutrition; discussion of community programs designed to help solve problems. Field trips in conjunction with programs of Iowa State Department of Health or Cooperative Extension Service.

414. SEMINAR IN COMMUNITY NUTRITION.  
(2-0) Cr. 2. S.  
Prerequisite: 413. Methods used in making dietary studies and judging apparent nutritional status; use of findings in planning community nutrition programs.

415. INTRODUCTION TO NUTRITION RESEARCH.  
(0-9) Cr. 3. F.W.S.  
Prerequisite: 305, B.&B. 305; Chem. 211 or B.&B. 311; permission of instructor. Introduction to methods used in nutrition research with application to selected problems.

418. METHODS OF TEACHING NUTRITION.  
(3-0) Cr. 3. S.  
Prerequisite: 409, Psych. 333. Objectives, organization of subject matter, practical application of methods and techniques for teaching patients, medical and dietetic interns, student nurses, and employees.

420. HISTORY OF FOOD.  
(2-3) Cr. 3. F.  
Prerequisite: 320, 8 credits in social sciences. Miller. Study of our food heritage; historical perspectives as they influence and determine present-day foods of families.

421. PRINCIPLES OF FOOD SCIENCE I.  
(2-6) Cr. 4. F.  

422. PRINCIPLES OF FOOD SCIENCE II.  
(2-4) Cr. 4. W.  
Prerequisite: 421. Miller. Experimental approach to the study of fats and oils and meats.

423. INTRODUCTION TO RESEARCH IN FOOD SCIENCE.  
(1-6) Cr. 3. S.  
Prerequisite: 422. Miller. Guidance and individual experience in planning, executing and reporting a problem in food research. Interpretation and evaluation of pertinent literature.

426. MULTICULTURAL FOOD PATTERNS OF FAMILIES.  
(0-6) Cr. 3. S.  
Prerequisite: 422 and permission of instructor. Study and preparation of the food and beverage common to and characterizing family foods in other countries.

490. SPECIAL PROBLEMS.  
Cr. arr.  
Prerequisite: Permission of Instructor.  
H. Honors Program.
COURSES PRIMARILY FOR GRADUATE STUDENTS, major or minor, open to qualified undergraduates

500. SHORT COURSE.
Cr. arr. SS.
Prerequisite: Permission of Instructor.

521, 522, 523. SELECTED STUDIES IN FOOD SCIENCE.
(1-6) Cr. 4 each. Yr.
Prerequisite: 215, B.&B. 301 or 311; Bact. 300.
521, 522: Experimental approach to the study of chemical and physical properties of interactive components of selected foods; correlated emphasis on selection, application, and evaluation of pertinent literature. 523: Individual design, execution, and summarization of the laboratory investigation of a problem in food research. Emphasis on development of critical evaluation and interpretation of data and supporting literature.

550. PROCESSED FOODS.
(3-0 or 6) Cr. 3 or 5.
Prerequisite: 411; 421 or 521.
Physical and chemical aspects of commercially prepared foods; methods of standardization, preservation, evaluation of quality.

590. SPECIAL TOPICS.
Cr. arr.
Prerequisite: 305.
A. Nutrition.
B. Food Science.
C. Professional Problems.

COURSES FOR GRADUATE STUDENTS, major or minor

601. PRINCIPLES OF NUTRITION.
(3-0) Cr. 3. W.
Prerequisite: 305, B.&B. 305.
Advanced study of nutrition. Required of all graduate students in the department.

606. CHEMICAL METHODS FOR RESEARCH IN FOOD AND NUTRITION.
(1-9) Cr. 4. W.
Prerequisite: 305; Chem. 211 or equivalent. Kenney.
Application of chemical techniques to research in nutrition.

607A, 607B. ANIMAL EXPERIMENTATION IN NUTRITION RESEARCH.
607A: (1-0 or 3) Cr. 1 or 2. W; 607B: (0-6) Cr. 2. S.
Prerequisite: 606 or Chem. 211 or equivalent. Arnrich.
The animal feeding experiment as a technique in nutrition research. Two quarters taken consecutively are required. Principles and basic experimental design using small laboratory animals. Individual problems in the animal laboratory.

609. SEMINAR.
Cr. R; F.W.S.
Required of all graduate majors in the Food and Nutrition Department.

615. ADVANCED NUTRITION.
(3-0) Cr. 3 each time elected. F.S.
Prerequisite: 601. Arnrich, Kenney, Roderuck, Runyan.
Series of one-term courses on such topics as proteins, vitamins, minerals, lipids, energy metabolism, evaluation of nutritional status. Classical and current research literature in each area.

619. RESEARCH METHODS IN FOOD SCIENCE.
(1-6) Cr. 3. F. or W.
Prerequisite: 521, 606. Carlin.
Application of physical, chemical, and organoleptic techniques to research in food science.

620. ADVANCED FOOD SCIENCE.
(3-0 or 2) Cr. 3 or 4.
Prerequisite: 619. Carlin.
Physical and chemical behavior of basic food constituents. Series of nonsequence courses on such topics as protein, fat, carbohydrate.

680. MODERN VIEWS OF NUTRITION.

699. RESEARCH.
A. Nutrition.
B. Food Science.

FOOD TECHNOLOGY

Verner H. Nielsen, Ph.D., Head of Department


Associate Professors: Allen A. Kraft, Ph.D.; William S. LaGrange, Ph.D.; Winfield S. Rosenberger, B.S.; Robert E. Rust, M.S.; Marvin H. Stromer, Ph.D.; David C. Topel, Ph.D.; Earl O. Wright, M.S.

Assistant Professors: Fred C. Parrish, Ph.D.; Ebenezer R. Vedamuthu, Ph.D.

Instructor: Robert V. Ogden, M.S.
Undergraduate Study

For undergraduate curriculum in Food Technology, see College of Agriculture, Curricula. Food technology is a curriculum administered by the College of Agriculture. It consists of the application of the sciences (especially chemistry, microbiology, and engineering) to the development, manufacture, marketing, and protection of food products. The many facets of food technology such as research, development, processing, packaging, quality control, marketing, foreign trade, and governmental supervision create a variety of interesting career opportunities. The curriculum is constructed according to the recommendations of professional societies. It has been made flexible so that a student after taking a core of basic courses in food processing, preservation, sanitation, and analysis may specialize in those fields of the food industry that are most attractive. The department offers especially strong programs in milk and meat technology.

Business

Students who are particularly interested in purchasing and sales management, marketing, and the economic aspects of the food industry may elect the business minor, in which courses in industrial management, economics, and communications replace some of the courses in chemistry and mathematics.

Special Programs

Students who wish to combine education in mechanical, chemical, or agricultural engineering with that in food technology may arrange a special five-year program leading to Bachelor of Science degrees in food technology and that of the engineering department selected.

Graduate Study

The department offers work for the degrees Master of Science and Doctor of Philosophy with majors in food technology, dairy microbiology, and meat science, and minor work for students majoring in other departments. Graduate work in meat science is offered as a joint major in animal science and food technology.

Prerequisite to major graduate work is the satisfactory completion of an undergraduate curriculum essentially equivalent to the food technology curriculum offered in this department or the completion of a curriculum in a related science such as dairy technology, bacteriology, chemistry, biochemistry, or engineering. Preparation in biology, chemistry, physics, and calculus along with knowledge of food processing, sanitation, and preservation are particularly desirable for those intending to pursue graduate work.

The foreign language requirement for the degree Master of Science is a reading knowledge of one foreign language, as evidenced by a score of 400 or more on the ETS examination. The foreign language requirement for the degree Doctor of Philosophy is a reading knowledge of one foreign language, as evidenced by a score of 500 or more on the ETS examination and by satisfactory completion of one year of college study in the same language. German, French, Russian, and Spanish are acceptable foreign languages. Other languages, including English for foreign students, may be acceptable based on the judgment of the student's graduate committee.

Courses open to graduate students for minor credit only: 305, 306, 307, 412, 414, 449, 450, 491, 492, 493. Exceptions may be made for graduate majors whose undergraduate preparation was not in food or a food-product technology but in a related science. Upon approval of their graduate committees, they may take dairy and food industry courses with 400 numbers for graduate credit.

COURSES PRIMARILY FOR UNDERGRADUATE STUDENTS

All courses with numbers less than 500 are open to undergraduate students on a satisfactory-fall basis.

110. TECHNICAL LECTURES. (1-0) Cr. R; F.
Orientation in preparing for a career as food technologist.

114. INTRODUCTORY FOOD TECHNOLOGY. (3-3) Cr. 3 or 4. W.S.
202. BASIC FOOD INDUSTRIES. (3-0) Cr. 3. W.
Prerequisite: 114 or permission of instructor.
Manufacture of basic food products. Food packaging. Application of new processes to the food industry.

207. EVALUATION OF DAIRY AND OTHER FOOD PRODUCTS. (0-3) Cr. 1 to 4. May be repeated for a maximum of 4 credits. F.W.
Principles and techniques of organoleptic evaluation of food products. Grades and specifications.

305. PROCESSING AND MARKETING OF FLUID MILK. (3-0 or 6) Cr. 3 or 5. F.
Prerequisite: Chem. 231 or 335; Bact. 300.
The application of microbiology, chemistry, and mechanics to the procurement, processing, and distribution of market milk; sanitary standards; control of chemical and bacteriological defects.

306. DAIRY PRODUCTS TECHNOLOGY I. (3-0 or 6) Cr. 3 or 5. W.
Prerequisite: 305.
Selected topics in food technology. Schedule of presentation will be announced.

307. DAIRY PRODUCTS TECHNOLOGY II. (3-0 or 6) Cr. 3 or 5. S.
Prerequisite: 305.
Technology of manufacture and marketing of domestic and foreign cheese. Manufacture of ice cream and related products.

412. FOOD PRESERVATION. (3-0 or 6) Cr. 3 or 5. S.
Prerequisite: Bact. 300.
Preservation, maintenance of quality of food products. Field trips.

414. FOOD, MILK AND WATER SANITATION. (3-0 or 6) Cr. 3 or 5. W.
Prerequisite: Bact. 300.
Control of biological, chemical, and physical environments in maintaining proper sanitation and safety of foods and water. Regulations governing sanitation. Field trips.

449. FOOD CHEMISTRY. (3-0) Cr. 3 or 5. F.
Prerequisite: Chem. 231 or 335. For students taking the laboratory, Chem. 211 or permission of instructor.
The structure, properties, and reactions of important food constituents and basic food commodities. The analysis and composition of food products.

450. DAIRY MICROBIOLOGY. (3-0) Cr. 5. F.
Prerequisite: Bact. 300.

490. SPECIAL PROBLEMS IN DAIRY AND FOOD TECHNOLOGY. (0-6 or 9) Cr. 2 or 3.
Prerequisite: Junior classification, quality-point average of 2.5 or more for preceding two quarters.
Laboratory investigations, assigned readings, and reports on chemical, microbiological, and processing problems of food products.

547. FOOD TECHNOLOGY. (2 or 3-0) Cr. 2 or 3. F.W.S.
Prerequisite: Permission of instructor.
Selected topics in food technology. Schedule of presentation will be announced.

559. ADVANCED DAIRY MICROBIOLOGY. (3-0 or 6) Cr. 3 or 5. W.
Prerequisite: 460. Reinbold.
Intensive study of microorganisms in milk products. Importance of beneficial and defect-producing microorganisms in manufacturing, packaging, and storing milk products.

COURSES FOR GRADUATE STUDENTS, major or minor

623. TOPICS IN FOOD CHEMISTRY. (3-0) Cr. 3. W.
Prerequisite: 449 or permission of instructor.
The chemistry of processes leading to changes in flavor, texture, or color in foods.

640. FOOD PROTEINS. (3-0) Cr. 3. Alt. F. offered 1971.
Prerequisite: B&B. 404 or permission of instructor.
Fundamental properties of protein systems found in milk, eggs, meat, and cereal grains. Effect of processing on food proteins.

656. ADVANCED FOOD MICROBIOLOGY. (5-0) Cr. 5. S.
Prerequisite: 450, Bact. 413 or permission of instructor.
Relation of the physiological and taxonomic grouping of microorganisms to the processing technology of dairy products, meats, poultry, eggs, fruits, and vegetables.

660. SEMINAR. (1-0) Cr. 1. F.W.S.

670. SPECIAL PROBLEMS IN FOOD TECHNOLOGY. Cr. arr.
Prerequisite: A major or minor in food technology or dairy microbiology.

FOREIGN LANGUAGES

Walter D. Morris, Ph.D., Head of Department

Professors: Don M. Anderson, Ph.D.; Cecil D. McVicker, Ph.D.; Frederick Schwartz, Ph.D.; Osvaldo Soto, Dr. en Der.

Associate Professors: Robert Bernard, Ph.D.; Tereze Michelsons, M.A.

Assistant Professors: Charlotte Bruner, M.A.; Arturo Graupera, Dr. en Der.; Harry A. Kahn, M.A.; Judith Noble La Casa, Ph.D.; Clyde Thogmartin, Ph.D.


Undergraduate Study

Courses offered by the department are designed to give students a knowledge of the fundamentals of the language and some appreciation of the culture of the people whose language is being studied.

The department offers majors in French, German, Russian, and Spanish, leading to the degree Bachelor of Arts. For a complete statement of degree requirements see Sciences and Humanities, Curriculum.

Majors in the various languages are expected to complete 36-39 credits in courses numbered 300 or above. These courses include sequences in civilization, sequences in both elementary and advanced composition and conversation, a varying number of courses in literature, and, in certain instances, a course or courses in linguistics. Majors in French will be required to complete a special course in pronunciation. Majors in any of the languages who hope to pursue graduate studies should make every effort to complete all offerings in the literature of the major language.

Candidates for teacher certification must complete professional education requirements in addition to the requirements outlined in the preceding paragraph. Majors in one language seeking approval to teach a second language and majors in other academic fields desiring to teach a language halftime or less may qualify by completing 30 credits in that language. For details, see College of Education. Prior to performing student teaching, any candidate for certification must demonstrate adequate speaking proficiency in the language to be taught.

Credits earned in professional education courses, including the language methodology course (F.L. 476) required of majors in the teacher education program, may be applied to fulfill the college's requirement for a minor area of concentration. Majors, including those in teacher education, are encouraged to consider minors or second majors in English language and/or literature, history, or international studies. For the latter, see International Studies.

Students who have completed three or more years of instruction at the high school level in a language taught by this department will be exempt from the general education requirement of the College of Sciences and Humanities. These students may receive up to 12 credits for a first-year language sequence by examination. Those who enter with two years but less than three years of instruction may satisfy the general education requirement in one of the following ways: (1) By satisfactory completion of an examination covering the college level basic sequence (first year) for which the grade P and appropriate credits toward graduation will be awarded. The examination, if failed, may be taken more than once only by petition. Failure to obtain credit by the above means requires that either option 2 or 3 below be satisfied. (2) By satisfactory completion of the intermediate (second year) sequence in the language in which high school instruction was received. (3) By satisfactory completion of the basic sequence in a language other than that for which high school credit was granted.

Students who are native speakers of a foreign language will not be granted credit in courses below the 300 level in their native languages nor in special basic language se-
quences offered under the designation 490 if the subject language is their native tongue. Furthermore, such students who are undergraduates and who have demonstrated proficiency in English (completion of the English 104-105 sequence with a grade of C or better) may use English in lieu of a second foreign language to satisfy the Group 7 requirement. See Sciences and Humanities, Curriculum. The student exercising this provision will be required to earn an additional 12 credits under one or more of the other group requirements.

COURSES PRIMARILY FOR UNDERGRADUATE STUDENTS

Courses in French

101, 102, 103. ELEMENTARY FRENCH.
(3-2) Cr. 4 each. 101: F.W.SSI; 102: W.S.SSI; 103: F.S.SSI.
Prerequisite: 101: Elementary sequence open only to students with less than two years instruction in French at the high school level; 102: 101; 103: F.S.SSI.
Introduction to French with emphasis on development of aural-oral skills with intensive use of the language laboratory.

101A. READING KNOWLEDGE OF SCIENTIFIC FRENCH.
(3-0) Cr. R: 88.
Prerequisite: C; F. Essentials of French grammar to permit use of the language as a research tool with aid of dictionary. For graduate students. Emphasis on problems of translation.

204. FRENCH PRONUNCIATION.
(2-1) Cr. 2, W.S.
Prerequisite: Credit or classification in 211. Short lessons, emphasis on pronunciation of French accent through phonetics, mechanics of sound formation, syllabification, intonation, and intonation.

207, 208, 209. SURVEY OF FRENCH LITERATURE.
(3-0) Cr. 3 each. Yr.
Prerequisite: 103.
Study of representative selections of French literature from its origins to modern times. Main emphasis upon reading comprehension. Lectures and discussions in English. Designed especially for non-majors with a requirement beyond the elementary course but recommended to majors as an introduction to 400-level courses in the novel, drama, and poetry. 207: Middle Ages, Renaissance, and 17th Century. 208: 18th and Early 19th Century. 209: Late 19th and 20th Century.

211, 212, 213. INTERMEDIATE FRENCH.
(2-2) Cr. 3 each. Yr.
Prerequisite: 211: 103; 212: 211; 213: 212.
Continued emphasis on development of aural-oral skills and mastery of basic principles of French grammar.

311, 312, 313. ELEMENTARY FRENCH COMPOSITION AND CONVERSATION.
(3-0) Cr. 3 each. Yr.
Prerequisite: 213.
Continuing review of grammar with a survey of literature as a basis for composition and conversation practice and improved reading skill. Incorporates an introduction to techniques of explication de textes to develop critical sense in preparation for advanced literature courses.

314, 315, 316. FRENCH CIVILIZATION.
(3-0) Cr. 3 each. Yr.
Prerequisite: 213.
Study of history, art, architecture, music, social institutions of France. Lectures and discussions in French. 314: Origins of the French nation through the Valois dynasty. 315: The Renaissance through the revolution. 316: The Napoleonic era through modern times.

401, 402, 403. ADVANCED FRENCH COMPOSITION AND CONVERSATION.
(3-0) Cr. 3 each. Yr.
Prerequisite: 313.
Intensive composition and conversation practice using literary masterpieces as a basis for development of an appreciation for style, idiomatic usages, and effective expression of ideas as well as for improvement of speaking and writing skills. Increased emphasis on vocabulary building, grammatical correctness, and compatibility of style and content.

407, 408, 409. FRENCH PROSE: THE DEVELOPMENT OF THE NOVEL FORM.
(3-0) Cr. 3 each. Yr.
Prerequisite: 313.
French prose from its beginnings to the present day with special emphasis on the development of the novel form. Lectures and discussions in French. 407: Early prose writings and the early novels through the age of enlightenment. 408: The century of the novel: Romanticism, Realism, Naturalism. 409: The novel since 1900.

410, 411, 412. FRENCH DRAMA.
(3-0) Cr. 3 each. Yr.
Prerequisite: 313.
French dramatic literature from the Middle Ages to the present day. Lectures and discussions in French. 410: Middle Ages and Renaissance theater; the beginnings of the classical drama, Corneille. 411: Classical drama, Racine and Molière; tragedy, comedy, and the Drame Bourgeois of the 18th century; Romanticism, Realism, and Naturalism in the theater. 412: The theater since 1900.

413, 414, 415. FRENCH POETRY.
(3-0) Cr. 3 each. Yr.
Prerequisite: 313.
French poetry from the Middle Ages to the present day. Lectures and discussions in French. 412: Epic, didactic, and lyric poetry of the Middle Ages; Renaissance poetry; poetry of the Classic Age. 414: 18th century poetry; poetry of the Romantic and Realistic movements, Parnassians and Symbolists. 415: The Moderns: Mallarmé, Verhaeren, Valéry, Aragon, Prévert, and others.
Courses in German

131, 132, 133. ELEMENTARY GERMAN.
(3-2) Cr. 4 each. 131: F.W.SSI; 132: W.S.SSI; 133: F.S.SSI.
Prerequisite: 131: Elementary sequence open only to students with less than two years instruction in German at the high school level; 132: 131, 133; 132.
Introduction to German through the aural-oral approach with intensive use of the language laboratory.

131A. 132A. READING KNOWLEDGE OF SCIENTIFIC GERMAN.
(3-0) Cr. R. 131A: SSI; 132A: SSI.
Essentials of German grammar to permit use of the language in research with aid of dictionary. For graduate students. Emphasis on problems of translation.

234, 235. SCIENTIFIC GERMAN.
(3-0) Cr. 3 each. 234: F; 235: W.
Prerequisite: 234: 133; 235: 234.
Review of grammar necessary for reading scientific literature. Extensive reading from the physical, biological, and social sciences.

236, 237, 238. INTERMEDIATE GERMAN.
(3-0) Cr. 3 each. 236; 237; 238: 237.
Prerequisite: 236: 133; 237: 236; 238: 237.

336, 337, 338. GERMAN CIVILIZATION.
(3-0) Cr. 3 each. Yr.
Prerequisite: 238.
German history, art, architecture, and music. Readings, lectures, and discussions in German.

Courses in Russian

121, 122, 123. ELEMENTARY RUSSIAN.
(4-1) Cr. 4 each. Yr.
Prerequisite: 121: Elementary sequence open only to students with no previous instruction in Russian; 122: 121; 123: 122.
Brief summary of essentials of construction necessary for reading knowledge. One hour of laboratory.

224, 225, 226. INTERMEDIATE RUSSIAN.
(3-0) Cr. 3 each. Yr.
Prerequisite: 224: 123; 225: 224; 226: 225.

324, 325, 326. ADVANCED RUSSIAN.
(3-0) Cr. 3 each. Yr.
Prerequisite: 326.
Composition and conversation based on masterpieces of Russian literature. Survey of Russian literature from the 10th Century to the present.

Courses in Spanish

151, 152, 153. ELEMENTARY SPANISH.
(3-2) Cr. 4 each. 151: F.W.SSI; 152: W.S.SSI; 153: F.S.SSI.
Prerequisite: 151: Elementary sequence open only to students with less than two years instruction in Spanish at the high school level; 152: 151; 153: 152.
Essentials of construction and vocabulary with an oral approach and with use of the language laboratory.

251, 252, 253. INTERMEDIATE SPANISH.
(2-2) Cr. 3 each. Yr.
Prerequisite: 251: 153; 252: 251; 253: 252.
Review of the basic elements of the Spanish language. Further intensive practice in oral communication.

351, 352, 353. INTRODUCTION TO SPANISH LITERATURE.
(3-0) Cr. 3 each. Yr.
Prerequisite: 253.
351: Drama of the Golden Age. Reading of one play each of Calderon and Lope de Vega in class with selected collateral readings. 352: Prose and poetry of the 19th century. Reading of selected prose and poetry from the romantic period to Galdos. 353: Prose and poetry of the 20th century. Selected readings from the Generation of '98 to the present. Lectures and discussion in Spanish.
Courses and Programs

354, 355, 356. ELEMENTARY SPANISH COMPOSITION AND CONVERSATION.
(3-0) Cr. 3 each Yr.
Practice in writing and speaking Spanish with emphasis on usage rather than on grammar and structure of the language.

357, 358, 359. SPANISH AND IBERO-AMERICAN CIVILIZATION.
(3-0) Cr. 3 each Yr.
Prerequisite: 253.
From earliest times to the present. Survey of the art and architecture, as well as the social structure of Spanish life. 359 is devoted exclusively to the study of Latin America. Lectures and discussion in Spanish.

451, 452, 453. HISPANIC POETRY.
(3-0) Cr. 3 each Yr.
Prerequisite: 353.
Hispanic poetry from epic times to the modern era. Poetry of Spanish America. Lectures and discussion in Spanish.

464, 465, 466. INTRODUCTION TO SPANISH AMERICAN LITERATURE.
(3-0) Cr. 3 each Yr.
Prerequisite: Twenty-four credits in Spanish.
464: The Colonial Period. Selected readings in historical and literary materials from the time of the conquest to the period of struggle for independence. 465: The 19th Century. Selected readings from the postcolonial period to include realism and modernism. 466: The Contemporary Period. Selected readings from prose and poetry of the 20th century. Lectures and discussion in Spanish.

467, 468, 469. ADVANCED SPANISH COMPOSITION AND CONVERSATION.
(3-0) Cr. 3 each Yr.
Prerequisite: 356.
Intensive use of the language laboratory for practice in diction, intonation, and oral interpretation of literary material. Writing of themes in Spanish on selected subjects of cultural value. Lectures and discussion in Spanish.

473, 474, 475. HISPANIC PROSE FICTION.
(3-0) Cr. 3 each Yr.
Prerequisite: 353.
Medieval times to the present. Spanish-American prose fiction in the 19th and 20th centuries. Lectures and discussion in Spanish.

477, 478, 479. HISPANIC DRAMA.
(3-0) Cr. 3 each Yr.
Prerequisite: 353.
Drama of Spain from the medieval period to the modern era. Drama of Spanish America. Lectures and discussion in Spanish.

Special Courses

476. METHODS OF TEACHING FOREIGN LANGUAGES.
(Educ. 476) Cr. 3 W.
Prerequisite: Eighteen credits in foreign languages.

490. SPECIAL PROBLEMS.
Cr. 1 to 6 each time taken.
Prerequisite: Permission of department head. Designed to meet the needs of students who seek work in areas other than those in which courses are offered, or who desire to integrate a study of literature or language with special problems in major fields. H. Honors Program.

491, 492, 493. INTRODUCTION TO ROMANCE LINGUISTICS.
(3-0) Cr. 3 each Yr.
Prerequisite: Reading knowledge of French or Spanish desirable.

FORESTRY

Henry H. Webster, Ph.D., Head of Department


Associate Professors: Raymond F. Finn, Ph.D.; Frederick S. Hopkins, Jr., Ph.D.; John C. Gordon, Ph.D.; Julius A. Larsen, Ph.D.; Dean R. Prestemon, Ph.D.

Assistant Professors: Donald I. Dickmann, Ph.D.; John C. Meadows, Jr., Ph.D.; Dean R. Yoesting, Ph.D.

Undergraduate Study

The department offers work for the degree Bachelor of Science with majors in forest resource management and forest products.

The forestry curriculum offers educational opportunities for students interested in positions of professional responsibility involving the management and administration of forest re-
sources and their utilization. Many private firms as well as various federal, state, and local agencies seek graduates of the forest management major to fill positions in timber, range, recreation, and watershed management. The pulp and paper, plywood, lumber, and other wood-using industries offer technical and supervisory opportunities in production, product development, quality control, and marketing to graduates of the forest products major. With appropriate graduate study, the range of opportunities is expanded to include research and education as well as more specialized administrative positions.

A six-week summer field studies program is conducted during the summer between the freshman and sophomore years, and is prerequisite to admission to the junior year.

Graduate Study

The department offers work for the degree Master of Science with majors in forest economics, forest management, forest mensuration, forest biology, and wood technology; the degree Master of Forestry with major in forestry, and the degree Doctor of Philosophy with majors in forest economics, forest mensuration, forest biology, and wood science.

Forestry minors are available to students taking major work in other departments. Study in the area of water resources is offered under a cooperative arrangement between the Department of Forestry and the departments of Agricultural Engineering, Agronomy, Bacteriology, Botany and Plant Pathology, Civil Engineering, Economics, Geology, and Zoology and Entomology.

Students desiring to major in this department should present forestry credits substantially equivalent to those required of undergraduate students in this institution.

There are no uniform language requirements for graduate study in forestry. No foreign language is required for the degree Master of Forestry. Foreign language requirements, if any, for the degree Master of Science and the Doctor of Philosophy are prescribed by the committee supervising the work of the individual graduate student in accord with his particular objectives and needs.


COURSES PRIMARILY FOR UNDERGRADUATE STUDENTS

101. INTRODUCTION TO FOREST RESOURCE MANAGEMENT. (3-3) Cr. 4. W.
Evaluation of trends in demand for forest products and services; implications for current and future management of public and private forest and related land and water resources; production possibilities, problems, policy issues.

102. SEMINAR: INTRODUCTION TO FORESTRY AND RECREATION RESOURCE MANAGEMENT. (1-2) Cr. 2. S.
Prerequisite: 101.
Professional functions in resource management; discussion of current developments and issues.

110. ORIENTATION. (1-0) Cr. R. F.
Discussion of forestry as a career. Orientation to activities and procedures of the Department of Forestry.

201. FOREST ECOLOGY. (0-8) Cr. 2. Summer Camp.
Field-oriented study of the forest ecosystem and its manipulation.

202. WOOD UTILIZATION. (0-8) Cr. 2. Summer Camp.
Timber products industries of an important forest area; techniques and problems encountered in harvesting and processing wood products; field study of efficient use of timber.

203. FOREST MEASUREMENTS. (0-8) Cr. 3. Summer Camp.
Field surveying and inventory sampling. Practice in measuring land, forest products, and forest stands. Data collection, analysis and estimation, and map and report preparation.

204. MULTIPLE USE OPERATIONS. (0-6) Cr. 2. Summer Camp.
Field study of forest and related resource problems and management programs. Interaction of user groups, forest industries, resource agencies, and local communities. Examination of conflicts, issues, and alternative solutions.

241. FOREST MENSURATION. (2-3) Cr. 3. F.
Prerequisite: Math. 162, Com.S. 201, Stat. 104.
Measurement of trees and forest stands. Principles of estimation by sampling and applications for inventorying forest resources.

256. DENDROLOGY. (Bot. 256) See Botany.

300. FOREST RESOURCE MANAGEMENT. (3-0) Cr. 3. F.
Prerequisite: 101.
A technical overview of mensurational, silvicultural, and managerial methods of concern to the specialist in forest-related activities. Not open to forest resource management students.
301. FOREST BIOLOGY. (3-0) Cr. 3. W.  
Prerequisite: 201, Bot. 256, 310, credit or classification in Agron. 387.  
Effects of genetic and environmental factors on tree processes underlying forest tree production.

302. FOREST VEGETATION MANIPULATION. (3-0) Cr. 3. S.  
Prerequisite: 301.  
The manipulation of forest vegetation in relation to ecological principles. Two one-day field trips.

357. FOREST SOILS. (Agron. 357) See Agronomy.

360. PARK AND RECREATION MANAGEMENT. (O.Rec. 360) See Outdoor Recreation Resources.

376. APPLIED ENTOMOLOGY. (Zool. 376) See Zoology and Entomology.

380. WOOD TECHNOLOGY. (3-8) Cr. 5. F.W.  
Prerequisite: Biol. 101.  
Anatomy, macroscopic identification, and introduction to chemical and physical properties of wood as related to processing.

386. WOOD LIQUID RELATIONS. (3-3) Cr. 4. F.  
Prerequisite: 360; Chem. 231 or equivalent. Cell wall structure; wood in relation to moisture; specific gravity; seasoning; protection of wood from insects and decay; fire retardant and stabilizing treatments.

390. FOREST PROTECTION. (3-0) Cr. 3. S.  
Prerequisite: Phys. 111.  
Character and extent of damage to forests by fire, weather, animals, and disease. Forest fire prevention, presuppression, and suppression. Fire control equipment.

397. FOREST REGULATION AND OPERATIONS. (3-9) Cr. 3. S.  
Prerequisite: 241, 301.  
Principles of organizing, regulating, and administering forest lands in conjunction with commercial harvest and multiple-use goals for both private and public ownership.

400. FOREST CONSERVATION. (3-0 or 3) Cr. 3 or 4. F.  
Prerequisite: Biol. 101.  
Not open to forestry students. Development of forest conservation, national, state, and private. Forests in relation to human needs. Forestry as related to other conservation work. Laboratory designed for students interested in farm forestry.

407. FOREST INFLUENCES. (3-0) Cr. 3. W.  
Prerequisite: 302.  
Influence of forests on climate, soil, water yield, and soil erosion. Water yield and soil erosion control.

416. FOREST PATHOLOGY. (Bot. 416) See Botany.

417. WOOD DETERIORATION. (Bot. 417) See Botany.

442. DYNAMICS OF FOREST STANDS. (2-3) Cr. 3. W.  
Prerequisite: 241.  

Prerequisite: Blat. 104.  
Methods for inventorying various forest resources and uses including range, water, and recreational resources. Estimating models and sampling schemes for providing estimates necessary to manage these resources within forestry context.

445. FOREST PHOTOGRAMMETRY AND PHOTO-INTERPRETATION. (2-6) Cr. 4. F.  
Prerequisite: 241, C.E. 201.  
Use of aerial photographs in forest management. Techniques of measurement, cartographic methods and interpretation applicable to controlled photographs.

451. MANAGEMENT OF FOREST RESOURCES: ECONOMICS AND MANAGEMENT. (3-3) Cr. 3. S.  
Prerequisite: 241, Econ. 242.  
Economic factors and analytical methods influencing decisions by forest resource agencies and firms. Marketing of services and products provided by such agencies and firms; influence of population, income, and related economic and social factors.

452. MANAGEMENT OF FOREST RESOURCES: QUANTITATIVE ANALYSIS. (3-3) Cr. 4. F.  
Prerequisite: 241, Econ. 242, C.S. 201.  
Methods for rigorously identifying and specifying problems involved in management, protection, and use of forest resources. Application of mathematical and statistical models in solving these managerial problems. Design and collection of information for use in these models.

453. MANAGEMENT OF FOREST RESOURCES: POLICY AND ADMINISTRATION. (3-0) Cr. 3. W.  
Prerequisite: 452, Pol.S. 215, senior classification.  
Analysis of the political, institutional, and administrative processes involved in the formulation of public and private policy concerning major forest resource issues.

454. MANAGEMENT OF FOREST RESOURCES: INTEGRATED CASE STUDIES. (1-4) Cr. 3. S.  
Prerequisite: 453.  
Organizing and administration of major forest resources. Emphasis on case studies to illustrate methods of synthesizing the economic, mathematical, biological, and administrative principles discussed in preceding courses.

460. FOREST RECREATION. (3-0) Cr. 3. W.  
Prerequisite: 461 or Econ. 242.  
Study of forest recreation in the United States. Relationship between forest recreation benefits and forest practices. Recreation policies and programs of public and private forest owners. Planning for recreation in forest management. Current problems and issues.

Prerequisite: 386; 396 recommended.  
Chemical processing of cellulose-derived products; carbonization; destructive distillation; hydrolysis.
484. PROPERTIES OF WOOD.
(3-9) Cr. 3. Alt. SS, offered 1972.
Prerequisite: 1.Ed. 205.
Structure and identification of wood; storage and handling of lumber; seasoning and other defects in lumber; machining and preparation of wood for gluing; woodworking glues. Not open to forestry majors.

485. WOOD COMPOSITE PRODUCTS.
Prerequisite: 386, one course in organic chemistry.
Principles of adhesion, chemistry of wood adhesives, production of laminated wood, plywood, particle board and fiberboard products. A weekly seminar on the properties of materials other than wood and a field inspection trip.

487. MECHANICAL PROCESSING OF WOOD.
(3-0) Cr. 3. Alt. S, offered 1972.
Prerequisite: 380.
Mechanical processing: sawing, planing, sanding, chipping, and defiberization. Use of wood in structures.

488. PHYSICAL PROPERTIES OF WOOD.
Prerequisite: 380; Phys. 111 or equivalent.
Wood in relation to heat, light, sound, and electricity. Introduction to wood mechanics.

489. WOOD PRODUCTS SEMINAR.
(0-2) Cr. 1. S.
Prerequisite: Senior classification.
Application of the principles of wood science to current industrial problems; detailed analysis of current events in the industry. Student presentation involved.

490. SPECIAL PROBLEMS.
Cr. 1 to 6 each time elected.
Prerequisite: Junior classification, permission of instructor.
A. Silviculture.
B. Wood Technology.
C. Forestry Economics.
D. Forest Management.
E. Range Management.
F. Forest Mensuration and Photogrammetry.
H. Honors Program.
I. Field Inspection Trip.

491. FOREST RANGE MANAGEMENT.
(3-0) Cr. 3. F.
The place of range management in multiple-use forestry. Historical development of grazing in America. Grazing regions of the United States. Effects of grazing on physiology and ecology of plants. Technical problems in range and ranch management.

COURSES PRIMARILY FOR GRADUATE STUDENTS, major or minor, open to qualified undergraduates

504. APPLIED FOREST BIOLOGY.
(3-0) Cr. 3. Alt. S, offered 1973.
Prerequisite: 302.
Detailed analysis of the practice of silviculture in relation to silvicultural principles.

543. FOREST MENSURATION.
(3-0) Cr. 3. Alt. W, offered 1973.
Prerequisite: 442.
Estimation of current stand volume and of stand growth. Selection of variables for volume and yield tables. Applications of sampling methods to forest resource surveys.

570. ECONOMICS OF FOREST PRODUCTION.
(2-2) Cr. 3. Alt. F, offered 1971.
Prerequisite: 451, Econ. 308.
Economic analysis of production alternatives in forestry firms. Critical analysis of related research.

580. CHEMISTRY OF WOOD.
(3-0) Cr. 3. Alt. W, offered 1973.
Prerequisite: 480, Chem. 334.
Chemical composition of wood; chemical reactions of wood components; techniques for characterizing wood components.

583. RHEOLOGY OF WOOD.
(3-0) Cr. 3. Alt. W, offered 1972.

COURSES FOR GRADUATE STUDENTS, major or minor

601. RESEARCH METHODS IN FORESTRY.
Scientific method; hypothesis formulation and testing; project and study planning; preparation and critical analysis of research plans. Communication of research results. Institutional factors in research.

602. ADVANCED FOREST BIOLOGY.
(3-0) Cr. 3. Alt. W, offered 1972.
Prerequisite: 302.
Detailed analysis of tree processes underlying forest tree production in relation to genetic and environmental factors.

645. ADVANCED FOREST MENSURATION.
(4-0) Cr. 4. Alt. S, offered 1972.
Prerequisite: 543, Stat. 401, 402, 421.
Theory and application of statistical and mathematical methods to forest measurement. Quantification problems in stand structure and growth. Sampling methods for forest inventory and estimation of past and future growth. Recent developments in forest mensuration.
670. RESOURCE ALLOCATION IN FORESTRY. (Econ. 670) (2-2) Cr. 3. Alt. S, offered 1972. Prerequisite: 451, Econ. 308. Critical examination of public and private forest-related problems, forestry programs designed to solve these problems, and related research.

688. FORMATION OF WOOD. (3-0) Cr. 3. Alt. W, offered 1972. Prerequisite: 380. Structure of the cell wall in woody plants. Measures of wood quality; environment as related to quality. Structure as related to the physical properties of wood.


GENERAL SCIENCE
Dr. Oscar E. Tauber, Chairman

Graduate Study
The program offers work toward the degree Master of Science with a major in general science. This program is available to graduate students who want or need a more diversified course of study than generally is permitted students who specialize in a single subject. Those who elect this program are allowed to take courses in three different subjects, each subject contributing approximately one-third of the required credits toward the degree. The courses which may be used for credit toward this degree are those listed in this catalog for graduate credit. In addition to completing a minimum of 45 credits, the student must meet the foreign language requirement of the department in which the thesis is supervised. A thesis, which may be based on field, laboratory, or library research, is required.

The program has been most useful to those who wish to improve their subject matter competence in teaching. Students who wish to qualify for this degree should consult the program chairman as soon as possible so that the committee for direction of the course of study may be appointed.

GENETICS
William J. Welshons, Ph.D., Head of Department

Professors: Willard F. Hollander, Ph.D.; Peter A. Peterson, Ph.D.; Donald S. Robertson, Ph.D.; Kiyoshi Sadanaga, Ph.D.

Associate Professors: John D. Imsande, Ph.D.; Wilmer J. Miller, Ph.D.

Assistant Professors: Alan G. Atherly, Ph.D.; Earle B. Doerschug, Ph.D.; Edward Pollak, Ph.D.

Instructor: John W. Day, M.A.

Undergraduate Study
The Department of Genetics offers instruction in the science of heredity, and in the operation of the laws of inheritance in animals, plants, microorganisms, and human populations. The courses also are intended to demonstrate the broad cultural and philosophical aspects of this biological science.

Graduate Study
The department offers work for the degrees Master of Science and Doctor of Philosophy with a major in genetics. Within the major the student may specialize in Drosophila, maize, oat, mouse, immunological, microbial, biochemical, and developmental genetics. Minor work is offered to students taking majors in other departments.
No foreign language is required of candidates for the degree Master of Science. Candidates for the degree Doctor of Philosophy are required to pass the E.T.S. examination for two foreign languages with a score of 400 or better.

Prerequisite to major work is the completion of a thorough undergraduate curriculum in a biological science, or in a physical science or in agriculture with evidence of excellent scholarship and aptitude for scientific research.

Students taking major work in genetics may take minor work in agronomy, animal science, bacteriology, biochemistry, botany, horticulture, mathematics, statistics, veterinary medicine or zoology.

Major and minor work in the area of cell biology is offered under a cooperative arrangement with the departments of Bacteriology, Biochemistry and Biophysics, Botany and Plant Pathology, Genetics, and Zoology and Entomology.

Open to graduate students for minor credit only: 401, 460.

### COURSES PRIMARILY FOR UNDERGRADUATE STUDENTS

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
<th>Prerequisites</th>
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<tbody>
<tr>
<td>301</td>
<td>Introductory Genetics</td>
<td>3-0</td>
<td>Cr. 3. F.W.S.SS</td>
</tr>
<tr>
<td>305</td>
<td>Elementary Genetics Laboratory</td>
<td>0-6</td>
<td>Cr. 2. F.W.S.</td>
</tr>
<tr>
<td>350</td>
<td>Principles of Genetics</td>
<td>3-0</td>
<td>Cr. 3. F.W.S.</td>
</tr>
</tbody>
</table>

*Prerequisites:
- Elementary course in college biology.
- Elementary principles of genetics and their operation and significance in plant, animal, human and microbial populations.
- Laboratory experiments illustrating the laws of heredity and their physical basis.

### COURSES PRIMARILY FOR GRADUATE STUDENTS, major or minor, open to qualified undergraduates

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
<th>Prerequisites</th>
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<tbody>
<tr>
<td>590</td>
<td>Special Topics</td>
<td>(0-3 to 9)</td>
<td>Cr. arr.</td>
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</tbody>
</table>

### COURSES FOR GRADUATE STUDENTS, major or minor

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
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</tr>
</thead>
<tbody>
<tr>
<td>605</td>
<td>Cytogenetics</td>
<td>3-0</td>
<td>Cr. 3. W.</td>
</tr>
<tr>
<td>615</td>
<td>Laboratory in Cytogenetics</td>
<td>0-6</td>
<td>Cr. 2. S.</td>
</tr>
<tr>
<td>620</td>
<td>Molecular Genetics</td>
<td>3-0</td>
<td>Cr. 3. S.</td>
</tr>
<tr>
<td>621</td>
<td>Bacterial Genetics</td>
<td>(Bact. 621)</td>
<td>See Bacteriology.</td>
</tr>
</tbody>
</table>

*Both 301 and 350 cannot be used for graduation credit. Both 350 and 401 cannot be taken for credit.*
390 Courses and Programs

630. ADVANCED PLANT GENETICS.
(3-0) Cr. 3. S.
Prerequisite: 350 or 401. Robertson.
Genetic analysis of plants including evolution, biochemical genetics, translation of genetic information, cytoplasmic inheritance, incompatibility systems, alterations of meiosis, and sex determination.

635. ANIMAL GENETICS.
(3-0) Cr. S. W.
Prerequisite: 305; 350 or 401. Hollander.
Analytical procedures by means of markers, with special regard to Drosophila; surveys of the status of genetic analysis in animals, especially domesticated species.

640. GENES AND MUTATIONS.
(3-0) Cr. 3. Alt. W, offered 1972.
Prerequisite: 350 or 401. Peterson.
Analysis of selected genes and mutations in microbial and higher forms. Topics include genetic fine structure, rates of mutation, units of recombination, controlling elements, and evolutionary aspects of mutation.

646. IMMUNOGENETICS.
Prerequisite: 350 or 401; Bact. 575 or consent of instructor. Miller.
Application of immunological principles to genetics; analytical procedures of blood typing, individual and species variation.

650. POPULATION GENETICS.

690. SEMINAR.
Cr. 1. F.W.S.

698. SEMINAR IN CELL BIOLOGY.

699. RESEARCH.

GEOGRAPHY

For description of courses, see Earth Science.

GEOLOGY

For description of courses, see Earth Science.

HISTORY

Walter Rundell, Jr., Chairman of Department

Professors: Richard N. Kottman, Ph.D.; Earle D. Ross, Ph.D.; Harold I. Sharlin, Ph.D.
Associate Professors: Leon J. Apt, Ph.D.; V. Alton Moody, Ph.D.; James W. Whitaker, Ph.D.
Instructors: Achilles Avraamides, M.A.; Don C. Rawson, M.A.

Undergraduate Study

For the undergraduate curriculum in sciences and humanities, major in history, leading to the degree Bachelor of Arts, see Sciences and Humanities, Curriculum.

The department offers introductory courses designed for all students as part of their general education, as an introduction to further study in their field, or as a complement to or preparation for vocational training. The department also offers courses for advanced undergraduate work in United States history, Latin American history, European history, Asian history, and history of science and technology.

Students majoring in history may substitute a second major in international studies for the minor requirement of the College of Sciences and Humanities. See International Studies.

A prelaw undergraduate program may be pursued through a major in history. For a more complete statement, see Preprofessional Programs.

Students can prepare to teach history in the secondary schools. For the University statement of requirements for teacher certification, see College of Education.
Graduate Study

The department offers work for the degree Master of Arts with majors in history and in history of science and technology. Both programs are designed to enable a graduate to teach in high schools and junior colleges, enter government service, or pursue further study.

Students may elect either a nonthesis program or a thesis program. Those choosing a nonthesis program will take oral comprehensive examinations over two survey fields, such as United States history, western civilization, or the like. Those writing a thesis will be examined orally on the thesis and its related historical milieu.

Open to graduate students for minor credit: any 400-level course.

COURSES PRIMARILY FOR UNDERGRADUATE STUDENTS

201, 202, 203. WESTERN CIVILIZATION.
(3-0) Cr. 3 each. Yr.
Prerequisite: 202; 201; 203; 202.
Social and cultural development of western civilization from the ancient Near East to the present, emphasizing western economic and political ideas and institutions; problems of historical change and continuity; basic methodology.

*221, 222, 223. HISTORY OF THE AMERICAN NATION.
(3-0) Cr. 3 each. Yr.
221: National foundations. Colonial background; revolution; confederation and constitutions; nationalism and democracy. 222: National expansion and internal conflict. Forces of unity and disunity, division and reunion. 223: National consolidation and world power; emergence of the new nation; modern industrialism and international relations.

286. BLACK AND WHITE IN AMERICA.
(3-0) Cr. 3. S.
Historical trends in race relations from 1619 to present. Slavery, segregation, and nature of black and white protests against these institutions.

*325, 326, 327. HISTORY OF ENGLAND AND GREAT BRITAIN.
(3-0) Cr. 3 each. Yr.

340, 341. HISTORY OF CHINA.
(3-0) Cr. 3 each. 340: F; 341: W.
Prerequisite: 341; 494.
340: Premodern China. Economic, intellectual, cultural, and social developments from earliest times to 1600. 341: Early impact of Europe on China; emergence of China as an important nation in the 19th century; nationalist and communist revolutions in the 20th century.

*350, 351, 352. HISTORY OF LATIN AMERICA.
(3-0) Cr. 3 each. Yr.
350: Pre-Columbian civilizations; Spanish and Portuguese discovery and colonization in America; development of colonial institutions to 1760. 351: Bourbon reforms of the late 18th century; wars of independence; organization of national states. 352: Society, economy, and politics of 20th-century Latin America.

375. HISTORY OF AMERICAN AGRICULTURE.
(3-0) Cr. 3. F.W.S.
American agricultural development from colonial times to the present.

*382, 383, 384. ECONOMIC HISTORY OF THE UNITED STATES.
(3-0) Cr. 3 each. Yr.
Prerequisite: Sophomore standing.
Growth of important industries, regional specialization; development of economic institutions, related to budgets and centripetal forces. 382: to 1828; 383: 1828-1900; 384: since 1900.

387A, 387B. MILITARY HISTORY OF THE UNITED STATES.
(3-0) Cr. 3 each. 387A: W; 387B: B.
Prerequisite: 387B: 387A.
Diplomatic, economic, political, and social causes and consequences of American wars; development of military and naval techniques, technology, strategy, and tactics. 387A: 18th and 19th centuries. 387B: 20th century.

399. HISTORICAL TECHNIQUES.
(3-0) Cr. 3. F.
Introduction to methodology for students majoring in history. Bibliographic techniques, methods of evaluating source materials, conducting research, and writing history.

*400A, 400B, 400C. ANCIENT HISTORY:
PRECLASSICAL MEDITERRANEAN WORLD.
(3-0) Cr. 3 each. Alt. Yr, offered 1971.
Prerequisite: Nine credits in history.

*403A, 403B, 403C. ANCIENT HISTORY: THE CLASSICAL WORLD.
(3-0) Cr. 3 each. Alt. Yr, offered 1972.
Prerequisite: Nine credits in history.
403A: Classical Greece 600-338 B.C. 403B: Hellenistic World; Alexander's conquests; his successors; rise of Rome, conquest of the Mediterranean world to 30 B.C. 403C: The Roman Empire from Augustus to Diocletian and Constantine, 30 B.C. - 312 A.D.

*404A, 404B, 404C. HISTORY OF MEDIEVAL WESTERN EUROPE.
(3-0) Cr. 3 each. Yr.
Prerequisite: Nine credits in history.
Development of political, economic, and social institutions. 404A: Early Middle Ages; 404B: High Middle Ages; 404C: Late Middle Ages.
407. THE ITALIAN RENAISSANCE.
(3-0) Cr. 3. W.
Prerequisite: Nine credits in history.
Secularization of society, city-states, economic growth and decline, new intellectual interests, historiography.

408. EUROPE: 1500 to 1648 (REFORMATION).
(3-0) Cr. 3. S.
Prerequisite: Nine credits in history.
The Northern Renaissance: emergence of religious dissent; Protestant revolt; triumph and tragedy of Spain; victory of Calvinism; reaction and reform within Roman Catholicism; religious wars and the emergence of France.

*410A, 410B, 410C. CONTEMPORARY EUROPE.
(3-0) Cr. 3 each. Yr.
Prerequisite: Nine credits in history.
410A: The Age of European pre-eminence, 1871-1914; 410B: The Great War and after; 410C: Europe since 1939.

*411A, 411B. ECONOMIC HISTORY OF MODERN EUROPE.
(3-0) Cr. 3 each. 411A: F; 411B: W.
Prerequisite: Nine credits in history.
411A: Economic and political revolutions 1750-1900; English and continental heritage from medieval Europe; commercial, industrial, agricultural, and colonial revolts; economic institutions, economic reforms, capitalism, competition, and imperialism.
411B: Rise of continental industry; changes in labor, transportation, markets, revolutions, reconstruction, competition, depression, and war.

*416A, 416B, 416C. HISTORY OF RUSSIA.
(3-0) Cr. 3 each. Yr.
Prerequisite: Nine credits in history.
416A: Klevan and Muscovite Russia, 850-1700. Origins of Russian state; Mongol invasion; rise of Moscow.
416B: Imperial Russia, 1700-1717. Peter the Great and his successors; impact of the West; eve of the Revolution.
416C: Soviet Union, 1917 to present. Revolution and Russian society; emergence of the USSR as a world power.

*421A, 421B. TUDOR-STUART ENGLAND.
(3-0) Cr. 3 each. 421A: F; 421B: W.
Prerequisite: Nine credits in history.

*430A, 430B, 430C. HISTORY OF SCIENCE.
(3-0) Cr. 3 each. Yr.
Prerequisite: Nine credits in history.
430A: Prehistory to Copernicus: Development of natural science in Babylonia, Egypt, China, India, Greece, Rome, medieval Europe, and Arabic science.
430B: Beginnings of modern science: the 16th, 17th, and 18th centuries in astronomy, mechanics, biology, and chemistry. Rise of scientific societies and the experimental method.
430C: Modern science: Development of natural science, chemistry, and biology in the 19th and 20th centuries.

431A. 431B. HISTORY OF ENGINEERING.
(Engr. 431A, 431B) See Engineering.

432. SCIENCE AND MODERN THOUGHT FROM 1650 TO PRESENT.
(3-4) Cr. 3. S.
Prerequisite: Nine credits in history.
Interaction of scientific with social, political, and economic thought.

433. MODERN JAPANESE HISTORY.
(3-0) Cr. 3. S.
Prerequisite: Nine credits in history.
Political, cultural, social, and economic history of Japan, particularly since 1853.

*462A, 462B, 462C. COLONIAL AMERICA.
(3-0) Cr. 3 each. Yr.
Prerequisite: Nine credits in history.
Expansion of Europe and colonial foundations. Economic, political, and social development to 1776.

464. THE JACKSONIAN MOVEMENT.
(3-0) Cr. 3. Alt. S., offered 1972.
Prerequisite: Nine credits in history.
Origins, development, and significance of Jacksonian democracy in determining and revealing the nature of American economic, social, and political mores and institutions.

466. SECTIONAL CONFLICT AND THE CIVIL WAR.
(3-0) Cr. 3. S.
Prerequisite: Nine credits in history.
Economic, social, political, and psychological conflicts which undermined the democratic process and drove the United States to Civil War.

468A. THE RECONSTRUCTION ERA 1865-1877.
(3-0) Cr. 3. W.
Prerequisite: Nine credits in history.
Major social and political features of the United States following the Civil War. The decision to reconstruct the South. Accomplishments and failures of reconstruction.

*469A, 469B, 469C. TWENTIETH CENTURY AMERICA.
(3-0) Cr. 3 each. Yr.
Prerequisite: Nine credits in history.
Major political, economic, and social developments of the nation from advent of Progressivism to present; emphasis on growth of the government as a regenerative force in American society. 469A: Progressive Movement, home front during WWII, red scare, and post-war reaction. 469B: New economic era of the 1920's, depression, Hoover administration, the New Deal. 469C: World War II, Fascism, Totalitarianism, the New Frontier, and the Great Society.

471. SOCIAL AND INTELLECTUAL HISTORY OF THE UNITED STATES.
(3-0) Cr. 3. S.
Prerequisite: Nine credits in history.
Development of social and intellectual movements, institutions, and leaders.

*474A, 474B. THE WESTWARD MOVEMENT AND FRONTIER DEVELOPMENT.
(3-0) Cr. 3 each. 474A: F; 474B: W.
Prerequisite: Nine credits in history.
474A: Occupation, distribution, and political organization of the public domain; Indian-white relations; 474B: Economic exploitation of the public domain (fur trade, mining, lumbering, range cattle industry, farming), social adjustments (law and order, religion, education, and culture).

*477A, 477B, 477C. HISTORY OF THE UNITED STATES FOREIGN POLICY.
(3-0) Cr. 3 each. Yr.
Prerequisite: Nine credits in history.
Diplomatic history, including penetration of American influence in those areas where the United States has exercised leadership. 477A: Diplomacy from the American Revolution to post-Civil War expansionism. 477B: America's rise as a world power from the Spanish American War to World War I; peace making. 477C: Diplomacy of 1920's to present.

478. U.S.-SOVIET RELATIONS.
(3-0) Cr. 3. F.
Prerequisite: Nine credits in history.
Diplomatic issues between the two states from the inception of the Soviet Union to the present; emphasis on period of nonrecognition and American intervention in Russian Civil War, and origins of the Cold War.
479A, 479B. INTER-AMERICAN RELATIONS.
(3-0) Cr. 3 each. 479A: F; 479B: W.
Prerequisite: Nine credits in history.
Relations between the United States and other nations of the western hemisphere; rise of United States influence in this area. 479A: 19th century. Evolution of Monroe Doctrine, Pan-Americanism, and economic penetration by the United States hegemony in the Caribbean, multilateralization of the Monroe Doctrine, and hemispheric solidarity.

479B: 20th century. United States hegemony in the Caribbean, multilateralization of the Monroe Doctrine, and hemispheric solidarity.

490. SPECIAL PROBLEMS.
Cr. 1 to 3 each time taken.
Prerequisite: Permission of department chairman; 9 credits in history.
Reading and reports on problems selected in conference with each student.
H. Honors Program.

COURSES PRIMARILY FOR GRADUATE STUDENTS, major or minor, open to qualified undergraduates

512A, 512B. EUROPEAN INTELLECTUAL HISTORY.
(3-0) Cr. 3 each. 512A: Alt. W; 512B: Alt. S, offered 1973.
Prerequisite: Nine credits in history.
512A: European ideas from the Renaissance through the Enlightenment. 512B: From the Enlightenment to the present.

515. HISTORY OF TECHNOLOGY IN THE UNITED STATES.
(Engr. 515) See Engineering.

517A, 517B. HISTORY OF MODERN GERMANY.
(3-0) Cr. 3 each. 517A: Alt. W; 517B: Alt. S, offered 1972.
Prerequisite: Nine credits in history.
517A: Central Europe in the 17th and 18th centuries. 517B: Economic, political, and social developments in 19th- and 20th-century Germany.

541. PHILOSOPHY OF HISTORY.
(3-0) Cr. 3. Alt. S, offered 1972.
Prerequisite: Nine credits in history.
Concepts of causality, time, determinism, nature, and generalization.

561. TECHNOLOGY IN DEVELOPING COUNTRIES.
(Engr. 561) See Engineering.

590. SPECIAL TOPICS.
Cr. 1 to 3 each time taken.
Prerequisite: Permission of instructor.

591A, 591B, 591C. SEMINAR IN HISTORY OF SCIENCE.
(3-0) Cr. 3 each. Yr.
Prerequisite: Permission of instructor.
591A: Creativity in sciences and humanities. Comparison of careers in these fields. Reasons for choice of career and how originality is expressed. 591B: Relation between science and technology. Effects of technological change on scientific thought and new theories on technology. Prehistory to present. 591C: History of science and technology.

592. SEMINAR IN EAST ASIAN HISTORY.
(3-0) Cr. 3. S.
Prerequisite: Permission of instructor.
Topics vary each time offered.

593. SEMINAR IN AMERICAN HISTORY.
(3-0) Cr. 3 each time taken.
Prerequisite: Permission of instructor.
Topics vary each time offered.
A. Colonial Period.
B. Jacksonian America.
C. Civil War and Reconstruction.
D. Twentieth Century.
E. Constitutional.
F. Diplomatic.
G. Economic.
H. American Frontier.
J. Intellectual.

594. SEMINAR IN EUROPEAN HISTORY.
(3-0) Cr. 3 each time taken.
Prerequisite: Permission of instructor.
Topics vary each time offered.
A. Ancient.
B. Medieval.
C. English.
D. Modern.
E. Diplomatic.
F. Economic.
G. German.
H. French.
I. Russian.
J. Intellectual.

596A, 596B. HISTORICAL METHODS.
(3-0) Cr. 3 each. 596A: F; 596B: W.
Prerequisite: 590A: Permission of instructor; 596B: 596A.
Original sources, bibliography, criticism of evidence, form.

COURSE FOR GRADUATE STUDENTS, major or minor

699. RESEARCH.
HOME ECONOMICS

Helen LeBaron Hilton, Ph.D., Dean of Home Economics
Julia Faitlison Anderson, M.S., Associate Dean
Marguerite Scruggs, Ph.D., Assistant Dean for Graduate Study and Research
Lydia L. Inman, Ph.D., Coordinator of Resident Instruction
Sandra E. Sime, B.S., Career Planning, Placement Director

Associate Professor: Irene Haynes Buchanan, M.S.
Assistant Professor: Jeannette M. Korslund, M.S.
Instructors: Marlene Armbrecht, M.S.; Edith E. Hewitt, B.S.; Elizabeth E. Kiser, B.S.; Joyce Scharers Pins, B.S.; Cheryl Jean Settle, B.S.

Courses Administered by the College of Home Economics

Courses listed below are offered for undergraduate students in all curricula of the College of Home Economics. See Home Economics Curricula. All courses are offered on satisfactory-fall basis only.

COURSES PRIMARILY FOR UNDERGRADUATE STUDENTS

150. COOPERATIVE WORK-STUDY PROGRAM.
Cr. arr. F.W.S.

190. SELF STUDY AND CAREER CHOICE OF WOMEN.
(2-0) Cr. 2. F.
Prerequisite: Permission of instructor.
Analysis of one's goals, interests, and abilities in relation to a woman's role in society and career opportunities in home economics.
Enrollment limited to freshmen and sophomores in home economics.

250. COOPERATIVE WORK-STUDY PROGRAM.
Cr. arr. F.W.S.

290. SPECIAL PROBLEMS.
Cr. arr.

350. COOPERATIVE WORK-STUDY PROGRAM.
Cr. arr. F.W.S.

400. PROFESSIONAL RELATIONS.
Cr. R: F.W.S., SSI.

COURSES FOR GRADUATE STUDENTS, major or minor

540. GRADUATE SEMINAR.
Cr. arr. F.W.S.
A. Interdepartmental
B. Field Trip

590. SPECIAL TOPICS.
Cr. arr.

HOME ECONOMICS EDUCATION

Ruth P. Hughes, Ph.D., Head of Department

Professors: Hester Chadderdon, Ph.D.; Florence Fallgater, D.Sc.; Lydia L. Inman, Ph.D.; Eleanore L. Kohlmann, Ph.D.; Marguerite Scruggs, Ph.D.

Associate Professors: Irene Beavers, Ph.D.; Virginia F. Thomas, Ph.D.

Assistant Professors: Alyce M. Fanslow, Ph.D.; Dorothea W. Gienger, M.S.; Lillie E. Magilton, M.S.; Blanche R. Miller, M.S.; Merlene E. Nelson, M.S.

Instructor: Gladys M. Ebert, M.S.
Undergraduate Study

For undergraduate curriculum in home economics education leading to the degree Bachelor of Science, see Home Economics Education, Curriculum.

The department offers work for the degree Bachelor of Science with major in home economics education. The curriculum is planned for those who wish to prepare for teaching in junior and senior high schools. By utilizing some elective credits for certain courses, this curriculum also prepares for home economics extension service.

Students may enroll in the department as sophomores but must apply to and be accepted by the departmental committee and the College of Education Committee on Academic Standards in order to advance to the teacher education program or preparation for extension service. For the teacher education program, including requirements for teaching certification, see College of Education.

Vocational Education Qualifications

The Department of Home Economics Education is approved by the State Board for Vocational Education for the preparation of teachers who desire to teach in approved vocational homemaking programs.

Preparation for Home Economics Extension Service

Students in home economics education will have a strong basic background for home economics extension service. For specific preparation see Home Economics, Curricula. Educ. 468 should be included. In addition, electives should be considered in consultation with the state leader of home economics extension programs, the coordinator of extension personnel training or district leaders for home economics programs. See also Extension Services.

Graduate Study

The department offers work for the degrees Master of Science and Doctor of Philosophy with major in home economics education and minor work to students taking major work in other departments.

A student expecting to do major work should have fundamental knowledge of psychology, education, sociology, and home economics. The exact requirements will depend upon the field of work the student expects to pursue.

A foreign language is not required for the degrees Master of Science or Doctor of Philosophy. Statistics is included in the program of study for both degrees with a higher level of competence required for the degree Doctor of Philosophy.

COURSES PRIMARILY FOR UNDERGRADUATE STUDENTS

406. METHODS OF TEACHING HOME ECONOMICS.
(3-3) Cr. 4. F.W.S.
Prerequisite: Educ. 305; admission into teacher preparation program.
Responsibilities of home economics educators in applying principles of learning and of adolescent development to instruction. Philosophy of home and family life education.

407. SUPERVISED TEACHING IN HOME ECONOMICS.
Cr. 9. F.W.S.
Prerequisite: 406, A.A. 261, C.D. 236, F.&N. 303, F.E. 254 or 318, F.E. 415 or 488, Sp. 211, T.&C. 125, cumulative grade-point average of 2.3.
Supervised teaching in approved centers of instruction. Advance reservation required.

410. PLANNING AND EVALUATING HOME ECONOMICS PROGRAMS.
Cr. 4. F.W.S.
Prerequisite: H.Ed. 407, 417. Developing plans for home economics educational programs for youth and adults of varied abilities and socioeconomic levels.

415. PRINCIPLES OF EDUCATION APPLIED TO HOME ECONOMICS.
(2-0) Cr. 2. W.
Prerequisite: Junior classification. Not open to majors.
Principles of planning and methods used in home economics educational programs.
COURSES PRIMARILY FOR GRADUATE STUDENTS, major or minor, open to qualified undergraduates

500. SHORT COURSE.
Cr. arr. S.S.
Prerequisite: Permission of instructor.
A. Adult Education.
B. Evaluation.
C. Curriculum.
D. Program Planning.
E. Supervision.
F. Teacher Education.

505. WORKSHOP.
Cr. 1 to 5. S.S.
Prerequisite: Permission of instructor.
Concentrated group study of problems in fields of home economics education. Sections offered will vary from year to year.
A. Adult Education. Beavers.
D. Supervision and Administration. Thomas.
E. Special.

507. TRENDS IN TEACHING HOME ECONOMICS.
(2 or 3-0) Cr. 2 or 3. F.S.S.
Prerequisite: Teaching experience.
Economic, political, and social changes affecting the home economics curriculum; the application of new knowledge and educational theory to curriculum planning; developments in organization, media, and methods for teaching home economics.

508. ADULT EDUCATION IN HOME ECONOMICS.
Education and related wage-earning occupations.
(3-0) Cr. 3. W.S.S.
Prerequisite: Nine credits in home economics education and, or education.
Contribution of home economics subject matter to adult education for home and family living, occupational training, and personal enrichment; methods of promoting, organizing, teaching, and evaluating adult programs; structure and goals of organizations and agencies related to home economics adult-education programs.

509. TEACHING FOR HOME ECONOMICS RELATED WAGE-EARNING OCCUPATIONS.
(1-2) Cr. 2. S.S.S.
Prerequisite: Nine credits in home economics education and, or education.
Planning and conducting courses for training adolescents and adults in home economics related wage-earning occupations. Planning and arranging business and industrial experiences for job trainees.

510. SPECIAL TOPICS.
Cr. arr.
Prerequisite: 406.
A. Adult Education.
B. Administration.
C. Curriculum.
D. Evaluation.
E. Extension.
F. Supervision.
G. General.
H. Teacher Education.
J. Research Methodology.

COURSES FOR GRADUATE STUDENTS, major or minor

605. HOME ECONOMICS CURRICULA.
(3-0) Cr. 3. W.S.S.
Prerequisite: Fifteen credits in education and teaching experience. Kohlmann.
Curriculum building applied particularly in home economics for secondary schools and colleges.

606. EDUCATIONAL LEADERSHIP AND SUPERVISION IN HOME ECONOMICS.
(3-0) Cr. 3. S.S.S.
Prerequisite: Five credits in graduate courses in home economics education. Thomas.
Objectives, principles, and functions of supervision in student teaching, school systems, and state departments of education.

609. ADULT EDUCATION IN FAMILY LIFE.
(3-0) Cr. 3. W.S.S.
Prerequisite: 508 or experience in adult education. Beavers.
Philosophy of family life education for adults. Interests and needs of various age and social groups. Methods and materials effective in group work and in educational media such as radio and television. Findings of research in the field of adult and family life education.

610. SEMINAR.
Cr. 1 each quarter. W.S.S.

611. DESIGN OF RESEARCH IN HOME ECONOMICS EDUCATION.
(3-0) Cr. 3. F.S.S.
Prerequisite: Credit or classification in Educ. 552 or Stat. 401. Fanslow.
Exploratory, descriptive, quasi-experimental, experimental, and historic research designs. Needed research in home economics education. Planning a research study. Evaluation of research reports.

612. EVALUATION IN HOME ECONOMICS.
(3-0) Cr. 3. S.S.S.
Prerequisite: Twelve credits in education. Selection and construction of evaluation devices. Their use and interpretation in home economics programs.

699. RESEARCH.
HONORS PROGRAM

Edwin C. Lewis, Ph.D., Chairman

The Honors Program provides an opportunity for exceptionally capable students to develop individualized degree programs by modifying the requirements in their curriculum, by skipping prerequisites, by engaging in independent study, and by participating in special courses and special sections of existing courses available only to Honors Program students. The purpose of the Honors Program is to meet the needs of those students who have demonstrated high capability and whose educational goals cannot readily be met through the normal degree program.

Each undergraduate college operates its own Honors Program, administered by a committee. This committee is responsible for admitting students to the program and for approving their degree programs.

Eligibility

Students are ordinarily not eligible for admission to the Honors Program until they have completed at least two quarters, nor will students with fewer than 72 credits remaining until graduation ordinarily be admitted. A cumulative grade-point average of 3.35 or above is normally required for admission, although a student with a lower grade-point average may apply for admission.

Special Educational Opportunities

The University Honors Program conducts Honors seminars, open only to small groups of Honors Program students. All members of the Honors Program are expected to enroll in at least one seminar each year. Honors seminars are offered only on a satisfactory-fail basis. Honors seminars are listed under University Studies 321H, 322H, and 323H.

Honors courses open only to Honors Program students, and Honors sections of regular courses, are offered by several departments. Those listed in this catalog include Psych. 230H, 333H, and 491H, and Sp. 211H. These are described in the departmental statements. Other special sections and courses are announced as they become available. The H designation may be used to create an Honors section of any course or to indicate that a student should receive Honors credit for work in a certain course.

Many departments offer opportunities for independent study or research under Special Problems listings in individual departments. When designated by H, a special project thus listed will carry Honors credit.

For further information concerning the Honors Program, see the University chairman in the Honors Program office, Room 102, Botany Hall.

HORTICULTURE

Ervin L. Denisen, Ph.D., Chairman of Department


Associate Professors: Griffith J. Buck, Ph.D.; James D. Kelley, Ph.D.; Charles H. Sherwood, Ph.D.; Benjamin F. Vance, B.S.; Jack L. Weigle, Ph.D.

Assistant Professors: Robert J. Bauske, Ph.D.; Charles W. Heuser, Ph.D.; Clinton F. Hodges, Ph.D.; M. LeRon Robbins, Ph.D.

Instructors: Allan R. Beck, B.S.; Elden J. Stang, M.S.
Undergraduate Study

For undergraduate curriculum in horticulture leading to the degree Bachelor of Science, see Horticulture, Curriculum.

The curriculum in horticulture with its four minors is designed for students desiring (1) technical horticulture with emphasis either in general horticulture, ornamental horticulture, floriculture, fruit and vegetable production, nursery management, or turfgrass management; (2) horticultural business; (3) horticultural science; and (4) horticultural teaching with emphasis on teaching general horticulture or extension horticulture.

Horticulture offers a career for both urban and rural students and for both men and women.

The broad field of horticulture provides new and expanded opportunities through current developing local, state, and national programs of beautification and recreation, teaching horticulture at high school and post high school levels, public arboretums and gardens, and food production for developing nations and disadvantaged citizens. The present curriculum minors have been designed to meet these needs and opportunities plus the traditional areas of study in horticulture.

Graduate Study

The department offers work for the degrees Master of Science and Doctor of Philosophy with major in horticulture, and minor work for students taking major work in other departments. Within the major the student may specialize in fruit crops, vegetable crops, floriculture, nursery crops, ornamentals, and turfgrass.

Prerequisite to major graduate work is the completion of courses covering the general field of horticulture or botany and the underlying sciences.

Students with major interest in fruit crops, floriculture, vegetable crops, nursery crops, ornamentals, or turfgrass should present 15 credits of undergraduate work in horticulture, botany, landscape gardening, or agronomy. The student also should have a working knowledge of inorganic and organic chemistry, general botany, and soils equivalent to the requirements outlined in the general curriculum for horticultural students at this institution.

Students taking major work in horticulture usually will take minor work in agronomy, genetics, botany (physiology, pathology, cytology, or morphology), entomology, statistics, or chemistry.

There is no uniform foreign language requirement for either the degree Master of Science or Doctor of Philosophy.

Open to graduate students for minor credit only: 413, 422, 446, 447, 467, 480, 481.

COURSES PRIMARILY FOR UNDERGRADUATE STUDENTS

110. INTRODUCTION TO HORTICULTURE.
(1-0) Cr. R; F.
Introduction of first-year students to the field of horticulture; assistance in learning how to use facilities of the University and department to advantage.

114. PRINCIPLES OF HORTICULTURE.
A: (3-0) Cr. 3. F.W.S.SSI; B: (0-2) Cr. 1. F.W.
S.SSI.
Horticulture in daily living; plant growth, environment, propagation, cultivation, pruning, irrigation, protection, harvesting, quality control, and selection; home grounds development and maintenance. Laboratory recommended.

146. HOME FLORICULTURE.
(0-4) Cr. 2. F.W.S.SSI. Not open to horticulture majors.
Principles and methods of growing house plants and garden flowers.

154. GREENHOUSE METHODS.
(2-2) Cr. 3. W.
Principles and methods of plant growing under glass, greenhouse construction and equipment.

214. PLANT PROPAGATION.
(2-2) Cr. 3. W.
Prerequisite: 114 or Biol. 101.
Fundamental principles underlying sexual and asexual propagation of plants, and practice in reproducing plants by use of seeds, leaves, stems, and roots.

224. SMALL FRUITS.
(2-2) Cr. 3. S.
Principles and practices involved in handling home and commercial plantings of vineyards and plantations of strawberries, bush fruits, and miscellaneous small fruits.

244. GARDEN FLOWERS.
(3-0) Cr. 3. S.SSI.
Culture and use of important garden flowers including annuals, perennials, bulbs, flowering vines, rock- and water-garden plants.
247A. 247B. FLORAL DESIGN.
247A: (1-1) Cr. 2. F.W.S; 247B: (1-2) Cr. 3. F.W.S.
Prerequisite: 247A: Not open to horticulture majors without permission of instructor; 247B: Open only to horticulture students.
Principles, mechanics, and uses of flower arrangements; conditioning and preparation of floral arrangement material; exhibiting and judging flowers and flower arrangements.

264. VEGETABLE CROPS.
(3-0) Cr. 3. S.
Prerequisite: 114 or Biol. 101.

314. TURFGRASS MANAGEMENT.
(Agron. 314) (3-0) Cr. 3. F.
Establishment and management of turfgrasses. Course examines grasses adapted to turf and their specific varieties; peculiarities of turfgrass establishment and management for home lawns, golf courses, athletic fields, and sod production. Special topics include fertilization, irrigation practices, soil drainage, and weed, insect, and disease control.

316. NURSERY MANAGEMENT.
(2-2) Cr. 3. S.
Prerequisite: Three credits in horticulture.
Equipment, including land, packing sheds, storage sheds, frames, glass houses, irrigation devices; large scale propagation; transplanting and management of plants; relation to other fields of horticulture; protection of nursery plants from climatic, disease, and insect difficulties.

321. TREE FRUITS.
(2-2) Cr. 3. F.
Prerequisite: 114.
Varieties, pest control, harvesting, grading, packing, and storage of orchard crops.

344. 345. HERBACEOUS ORNAMENTAL PLANTS.
(2-0) Cr. 2 each. 344: F; 345: W.
Prerequisite: 114A.
344: Nomenclature, derivation, development, and classification of annuals, biennials, subshrubbery, and herbaceous perennials of ornamental importance in landscape planting. 345: Growth characteristics of herbaceous ornamental plants. Emphasis upon environmental relationships and environment modification requisite to successful usage and the diagnosis and treatment of management problems.

401, 402, 403. SEMINAR.
(1-0) Cr. 1 each. Yr.

413. TURFGRASS SCIENCE.
Prerequisite: 314, Biol. 101, Bot. 107, 310.
The grass plant: structure, growth, and physiology in relation to the physical (soil, water, light, fertility) and biological (soil microorganisms and pathogens) environment.

414. MARKETING HORTICULTURAL PRODUCTS.
(3-0) Cr. 3. Alt. W, offered 1972.
Prerequisite: 114.
Areas of production of horticultural crops, standardization, inspection, transportation, storage, price trends, agents of distribution, market news service, foreign markets, cooperative markets.

422. ORCHARDING.
Prerequisite: 321.
Propagation, planting, pruning, maintenance, physiology of growth, and storage of orchard crops.

446. 447. FLORICULTURAL SCIENCE.
Prerequisite: 446: 154; 447: 446.
446: Culture and propagation of florist bench crops and potted plants. 447: Culture of tender bedding plants; marketing cut flowers; organization and management of greenhouse and retail store.

467. HORTICULTURAL TECHNOLOGY.
(3-0) Cr. 3. Alt. W, offered 1973.
Prerequisite: Bot. 310, Agron. 354, permission of instructor.
Application of new technology to the production and handling of horticultural crops, including current aspects of soil fertility, variety development, post-harvest physiology, and mechanization.

480. SYSTEMATIC HORTICULTURE I.
(2-2) Cr. 3. Alt. F, offered 1971.
Origin, identification, classification, description, and genetics of woody ornamental plants.

481. SYSTEMATIC HORTICULTURE II.
Origin, identification, classification, description, and genetics of conservatory plants.

490. SPECIAL PROBLEMS.
Cr. arr.
Prerequisite: Ten credits in horticulture and junior standing.

COURSES PRIMARILY FOR GRADUATE STUDENTS, major or minor, open to qualified undergraduates

501. HORTICULTURAL FOOD CROPS.
(2-2) Cr. 3. Alt. F, offered 1971.
Comparative classification of fruits and vegetables based upon physiological, morphological, and cytogenetical similarities and differences; their horticultural use as related to these factors.

514. HORTICULTURAL SCIENCE.
(3-0) Cr. 3. Alt. W, offered 1973.
Prerequisite: Three credits in plant physiology, Agron. 354, Stat. 101.
The physiological bases for horticultural techniques or practices and the effect of environment in modifying these techniques.

518. GENETICS AND BREEDING OF HORTICULTURAL PLANTS.
(3-0) Cr. 3. Alt. W, offered 1972.
Prerequisite: Gen. 301.
A study of genetic systems and breeding techniques or methods that are of particular value to the improvement of horticultural plants.

590. SPECIAL TOPICS.
Cr. arr.
Prerequisite: A major or minor in horticulture.
COURSES FOR GRADUATE STUDENTS, major or minor

604. GRADUATE SEMINAR.
Cr. 1 each time elected. F.W.S.

621. CURRENT TOPICS IN OLERICULTURE.
Cr. 2. Offered as arr.
Review and discussion of current literature and problems concerning the genetics, physiology, and culture of vegetables.

622. CURRENT TOPICS IN POMOLOGY.
Cr. 2. W.
Review and evaluation of current investigations on fruit breeding, physiology, mechanization, handling, and storage.

624. PHYSIOLOGY OF HORTICULTURAL PLANTS.
Cr. 3. Alt. S, offered 1972.
Prerequisite: Botany 513, permission of instructor. Application of plant physiology to the problems of sexual and asexual propagation, dormancy, and fruit development.

699. RESEARCH.
Cr. 1 to 11.

HOUSING

Advisory Committee: Margaret I. Liston, Ph.D., Chairman; Thomas A. Barton, M.L.A.; Martin D. Gehner, M.Arch.; Clair B. Watson, M.F.A.

Work in housing is offered for the degrees Master of Architecture, Master of Landscape Architecture, Master of Arts, or Master of Science as appropriate in the following cooperating departments or major areas: Applied Art, Architecture, Family Environment, Landscape Architecture, or Town and Regional Planning.

A student majoring in housing will choose his major professor from the graduate faculty membership of the cooperating departments and will develop his program for study under the guidance of a committee nominated by the advisory committee and appointed by the dean of the Graduate College.

For administrative purposes the student will be considered as majoring in the department of the major professor and will be listed as having the degree in that department with emphasis on housing.

Programs in housing should be planned to include courses from several of the following departments:


1Graduate credit not available.
2Graduate credit not available to majors in this department.
HYGIENE

Gail McClure Proffitt, M.D., Head of Department

Assistant Professor: Earl Murphy, M.P.H.

Undergraduate Study

For the Student Health Service of the Department of Hygiene, see Health Service.

The Department of Hygiene offers instruction in the area of personal health education with the aim of motivating the student to learn and apply to everyday life recommended standards of health practices. The department also offers instruction in school health education designed primarily for physical education majors who are usually called upon to be responsible for health instruction along with their physical education activities.

COURSES PRIMARILY FOR UNDERGRADUATE STUDENTS

104. PERSONAL HEALTH EDUCATION.
(3-0) Cr. 3. F.W. Murphy.
Physical, mental, and social aspects of health as a basis for understanding and preventing personal health problems.

105. EMERGENCY HEALTH CARE.
(0-2) Cr. 1. F.W.S. Murphy.
Concepts and methods.

304. SCHOOL HEALTH EDUCATION.
(3-0) Cr. 3. F.W.S.
Prerequisite: 104. Murphy.
Topics such as healthful school living, health education, health screening, teaching methods, relationship of community health agencies to the total process of health education.

490. SPECIAL PROBLEMS.
Cr. var.

IMMUNOBIOLOGY

Advisory Committee: Merlin L. Kaeberle, D.V.M., Ph.D., Chairman; Wilmer J. Miller, Ph.D.; Loyd Y. Quinn, Ph.D.

Work is offered for the degrees Master of Science and Doctor of Philosophy with major in immunobiology under a cooperative arrangement with the departments of Agronomy, Animal Science, Bacteriology, Biochemistry and Biophysics, Botany and Plant Pathology, Food and Nutrition, Food Technology, Forestry, Genetics, Horticulture, Veterinary Clinical Sciences, Veterinary Microbiology and Preventive Medicine, Veterinary Pathology, and Zoology and Entomology. Facilities exist in several departments for fundamental research in such areas as immunogenetics, physiology of antibody formation, immunofluorescence microscopy, immunocytochemistry, immunocytochemistry, immunopathology, immunoparasitology, microbial immunology, and serology.

A student majoring in immunobiology will choose a major professor from the graduate faculty membership of cooperating departments and will develop his program of study under the guidance of a committee nominated by the administrative department head, approved by the immunobiology advisory committee and appointed by the dean of the Graduate College. For administrative purposes the student will be assigned to the department of his major professor.

Students desiring to do graduate work with a major in immunobiology should have a bachelor's degree or equivalent in one of the areas related to the cooperating departments listed above and should qualify for admission to one of these departments. A strong background in biological sciences is desirable, including work in immunology, genetics, and biochemistry. Students who do not have these prerequisites should plan to complete them in addition to the regular course requirements for the advanced degree.

Immunobiology majors should include in their program of study a core of courses chosen from those listed below and comprising the basic program in Immunobiology. Formal courses in biochemistry and statistics are recommended. The following courses are also appropriate for inclusion in the program: Bact. 509, 601, 615, 645, 660, 678; B.& B. 574, 575; C.Bio. 527, 528; Gen. 605, 615; Stat. 411; Vet. Micr. 526, 625; Vet. Pth. 653; Zool. 529.
COURSES FOR GRADUATE STUDENTS, major or minor

520. SEROLOGY. (V. Micr. 520) See Veterinary Microbiology.

575. IMMUNOLOGY. (Bact. 575) See Bacteriology.

620. MOLECULAR GENETICS. (Gen. 620) See Genetics.

629. MEDICAL IMMUNOLOGY. (V. Micr. 629) See Veterinary Microbiology.

646. IMMUNOGENETICS. (Gen. 645) See Genetics.

675. ADVANCED IMMUNOLOGY. (Bact. 675) See Bacteriology.

690. SPECIAL TOPICS. Cr. arr. Offered on request with approval of advisory committee.
Prerequisite: Twelve credits in immunobiology; permission of instructor.
Experimental methods applied in subdisciplines of immunobiology:
A. Immunochemistry.
B. Immunocytology.
C. Immunogenetics.
D. Immunologic Disease.
E. Immunoparasitology.

695. SEMINAR. (1-0) Cr. 1. F.S.
Prerequisite: Permission of instructor. Kaeberle. Concepts and research in immunobiology.

INDUSTRIAL ADMINISTRATION

W.H. Thompson, Ph.D., Chairman of Department

William H. Schrampfer, J.D.; Harry L. Shadle, Ph.D.; Martin Zober, Ph.D.

Associate Professor: Charles B. Handy, Ph.D.

Assistant Professors: Gary L. Aitchison, M.A.; Bruce D. Collins, M.A.; John I. Coppett, M.B.A.;
R. Nelson, M.B.A.; Roderick D. Powers, M.S.; Merrill K. Sharp, M.S.

Instructors: Richard D. Horn, M.B.A.; Barbara McGill, M.S.; James H. Miller, M.B.A.; Roger
P. Murphy, M.S.; Phillip T. Senatra, M.A.; Barry H. Spraggins, M.B.A.; David S. Steinbruegge,
M.A., M.B.A.

Undergraduate Study

For the undergraduate curriculum in the College of Sciences and Humanities, major in
industrial administration, leading to the degree Bachelor of Science, see Sciences and Human­
ities, Curriculum.

The Department of Industrial Administration provides preparation for those who are in­
terested in business and industry and have a business management position as a goal. Each
student is required to complete a program which includes a core of basic business courses
and to select an option from the following areas: accounting, finance, marketing, transportation,
physical distribution, or general business. A prelaw program of study is offered by the de­
partment. The departments of Economics, Industrial Engineering, and Psychology offer sup­
plementary instruction in the areas of industrial relations, employer-employee relations, pro­
duction management, and personnel supervision.

Interdepartmental programs are offered with a major in industrial administration and
minors in the following areas: (1) Curriculum in Construction Engineering, Department of Civil
Engineering. A program of study is provided for those students interested in the construction
industry. (2) Department of Institution Management, College of Home Economics. A program
of study is provided for those students interested in the food service industry. (3) Journalism
and Mass Communication, College of Sciences and Humanities. A program is provided for
students preparing for positions in advertising, public relations, and similar management posi­
tions. For additional information either department head may be consulted.

Graduate Study

Open to graduate students for minor credit only: 425, 440, 443, 444, 445, 463, 464, 467,
470, 480, 481, 490, 491.
COURSES PRIMARILY FOR UNDERGRADUATE STUDENTS

150. INTRODUCTION TO INDUSTRIAL ADMINISTRATION.
   (3-0) Cr. 3. F.W.S.S.
   Orientation of business to modern society.

340. PRINCIPLES OF MARKETING.
   (3-0) Cr. 3. F.W.S.S.
   Prerequisite: Econ. 242.
   Market potential, institutions, functions, commodities, and the marketing mix as they relate to the flow of goods. Microanalysis and microanalytic aspects considered along with behavioral, quantitative, national, and international implications.

350. BUSINESS FINANCE.
   (3-0) Cr. 3. F.W.S.S.
   Prerequisite: 385, Econ. 242.
   Introduction to financial management to acquaint students with financial planning, financing, and effective use of funds provided.

355. REAL ESTATE FINANCE.
   (Con. E. 355) (3-0) Cr. 3. F.W.
   Prerequisite: 350 or Con. E. 246.
   Value analysis of real estate forms from the viewpoint of the business user and the professional investor.

360. PRINCIPLES OF TRANSPORTATION.
   (3-0) Cr. 3. F.W.S.S.
   Prerequisite: Econ. 242.
   Historical development and current role of transportation in the United States. Economic problems and public policy pertaining to transportation agencies; emphasis on the railroads.

365. BUSINESS LAW I.
   (3-0) Cr. 3. F.W.
   A. For students in engineering.
   B. For students in agriculture.
   C. For students in science and home economics.
   Fundamental principles of law as applied to business transactions and business relationships. Affords the student an opportunity to appreciate our legal system as an agency of social control as well as to observe good business technique and practice.

366. BUSINESS LAW II.
   (3-0) Cr. 3. F.W.
   Prerequisite: 365.
   Sales and negotiable documents of title; security relationships; credit instruments.

368. BUSINESS ORGANIZATION AND MANAGEMENT.
   (3-0) Cr. 3. F.W.S.S.
   Prerequisite: Credit or classification in Econ. 242.
   Organization of a business firm as a social institution and as a functioning unit within the economic, social, and political environment.

371. INDUSTRIAL ACCOUNTING.
   (3-0) Cr. 3. F.S.
   Theory and procedure of general accounting, introductory survey of cost accounting objectives and procedures. A terminal course for engineers not planning further study in accounting. This course does not meet prerequisite for 385 or 480. Either 371 or 384, but not both, will count toward graduation.

384. 385. PRINCIPLES OF ACCOUNTING.
   384: (3-2) Cr. 4. F.W.S.S.; 386: (3-0) Cr. 3. F.W.S.S.
   Prerequisite: 384.
   384: Introduction to principles and procedures of general accounting, development of accounting reports on an accrual basis, business terminology, managerial control procedures relating to service and retail organizations. Either 371 or 384, but not both, will count toward graduation.
   385: Continued development of accounting principles and procedures relating to problems of the corporate entity, measurement and control of costs for a manufacturing business, special analysis in the financial position of the company, and its data; development of the income statement and the valuation and control of economic resources presented on a statement of financial position, analysis of current liabilities.

386. INTERMEDIATE ACCOUNTING.
   (3-0) Cr. 3. F.W.S.S.
   Prerequisite: 385.
   Procedures and theory related to elements of an income statement and the valuation and control of economic resources presented on a statement of financial position, analysis of current liabilities.

425. FEDERAL INCOME TAX.
   (3-0) Cr. 3. F.W.S.S.
   Prerequisite: 371 or 384.

428. FINANCIAL INFORMATION SYSTEMS.
   (3-0) Cr. 3. F.S.
   Prerequisite: 386.
   Analysis of concepts and procedures underlying the accumulation and processing of business data; development of effective management information systems, internal control techniques, and trends in information systems.

440. INDUSTRIAL PURCHASING.
   (3-0) Cr. 3. F.
   Prerequisite: 340.
   The purchasing function, management, purchase of optimum quantity, standardization, quality control, store control, purchasing research, and computer applications.

443. MARKETING MANAGEMENT.
   (3-0) Cr. 3. F.W.
   Prerequisite: 340.
   Marketing decisions with emphasis on pricing, advertising, personal selling, product development, and channels of distribution. Cases and use of computer will be employed.

444. MARKETING RESEARCH.
   (4-0) Cr. 4. W.S.
   Prerequisite: 443.
   Problem formulation, research design, questionnaire construction, sampling and interviewing of consumers and businessmen. Marketing research techniques.

445. PRINCIPLES OF INVESTMENTS.
   (4-0) Cr. 4. F.W.
   Prerequisite: 385.
   Mechanics of investment and secondary capital markets, individual and institutional investment in limited-income securities common stocks. Use of computer in portfolio selection. Also required is a dictated study of a business and the industry of which it is a part.

460. PHYSICAL DISTRIBUTION AND TRAFFIC MANAGEMENT.
   (3-0) Cr. 3. F.W.
   Prerequisite: 360.
   Distribution management integrating traffic through cooperative functions of materials handling, inventory control, warehousing, and facility location. Traffic organization, functions of carrier selection, determination of rates, classification, routing, and carrier liability. Field trips.

463. HIGHWAY TRANSPORTATION.
   (3-0) Cr. 3. F.W.
   Prerequisite: 360.
   Analysis of resource allocation in the highway sector. Financing and development of highways. Managerial and economic aspects of motor transportation and its role in economic and social life.
464. **BUSINESS LOGISTICS.**
(4-0) Cr. 4. F.W.S.
Prerequisite: 460.
Management of flow of materials from the source of supply through processing to ultimate market-place delivery. Design and application of methods for the solution of physical movement problems of business firms. Field trips.

466. **AIR AND WATER TRANSPORTATION.**
(3-0) Cr. 3. Alt. S, offered 1973.
Prerequisite: 360.
Role of commercial air and inland water carrier services in traffic patterns of the nation. Cooperation, coordination, and competition of these services with land-based systems of transportation. Evaluation of the impact of technological improvements and federal policies upon local, regional, and national economic and social development.

467. **PUBLIC UTILITIES.**
(3-0) Cr. 3. F.S.
Prerequisite: Econ. 242.
Nature of the public utility concept. Theories of valuation and rate of return; plant operations and utility capital structures. Division of regulatory control between state and national government. Private and public ownership of utilities in the United States.

469. **TRANSPORTATION SEMINAR.**
(3-0) Cr. 3. S.
Prerequisite: 464.
Contemporary problems in the field of transportation.

470. **SALES FORECASTING.**
(3-0) Cr. 3. W.S.S.
Prerequisite: 340 recommended, Stat. 127.
Time series, regression, exponential smoothing, cycle analysis, mathematical models, survey techniques, and nonmathematical methods; models of calculating gross national product, including use of input-output tables.

474. **ADVANCED BUSINESS FINANCE.**
(3-0) Cr. 3. W.
Prerequisite: 350, 386.
Allocation of funds within a firm: capital budgeting, mergers, consolidations, reorganization, and valuation problems in selling a going concern.

477. **FINANCE SEMINAR.**
(3-0) Cr. 3. S.
Prerequisite: 445, 474.
Contemporary problems, pertinent topics and current research in the areas of business, finance, investments, and investment analysis. Broad reading and individual investigation of specific financial problems and policies required.

480. **COST ACCOUNTING.**
(4-0) Cr. 4. F.W.S.
Prerequisite: 385, or 384 and permission of instructor.
Product costing and control as they relate to job order, process, and standard-cost systems. Introduction to cost-volume-profit relationships, budgeting, and profit planning. Field trips.

481. **ADVANCED COST ACCOUNTING.**
(3-0) Cr. 3. S.
Prerequisite: 480.
Further development of product costing and control procedures. Cost reports as an aid in managerial decision making, capital budgeting, distribution costs, direct costing, responsibility accounting, profit centers, and transfer pricing. Field trips.

488. **SALES MANAGEMENT.**
(3-0) Cr. 3. S.S.S.
Prerequisite: 340.
Exploration of the functional aspects of sales force management. Includes discussion of procedures for recruiting, selecting, and training new salesmen; compensation and expense control systems; problems of sales force motivation and supervision; methods of territorial and quota assignment; sales department budgets; distributor-dealer relations; and other selected topics.

490. **SPECIAL PROBLEMS.**
Cr. 1 to 3 each time taken.
Prerequisite: Senior standing, permission of instructor.

491. **GENERAL INSURANCE.**
(3-0) Cr. 3. F.S.S.
Prerequisite: 365.
Risk and risk bearing as applied to individuals and business firms. Insurance and probability. Fundamentals of insurance contracts with special emphasis on life and health, with some attention given to automobile insurance.

495. **ADVANCED ACCOUNTING I.**
(3-0) Cr. 3. F.
Prerequisite: 386.
Accounting theory related to stockholders' and creditors' interests in corporations, research on accounting problems in current periodicals and publications, theory and practice in selected accounting problems. Field trips.

498. **ADVANCED ACCOUNTING II.**
(3-0) Cr. 3. W.
Prerequisite: 386; 495 recommended.
Accounting for business combinations and affiliated companies; branch operations, consolidated financial statements, "purchase" versus "pooling-of-interests" interpretation of consolidations; reporting foreign operations; present-value concepts. Field trips.

497. **AUDITING.**
(3-0) Cr. 3. W.
Prerequisite: 495.
Internal control procedures in modern business; development of auditing standards and procedures as applied by Certified Public Accountants; review of internal auditing activities. Field trips.

498. **ACCOUNTING SEMINAR.**
(3-0) Cr. 3. S.
Prerequisite: 481, 496, 497.
Integration and expansion of accounting theory and practice as they relate to operation of both the controllership function in business and the public accounting profession. Field trips.
INDUSTRIAL EDUCATION

William D. Wolansky, Ed.D., Professor in Charge

Professor: Lowell L. Carver, M.S.

Associate Professors: Gerald A. Parks, Ed.D.; Lillian C. Schwenk, Ph.D.; Albert M. Sherick, M.S.; Merle O. Wiener, M.S.


Undergraduate Study

The undergraduate curriculum in education, major in industrial education, leading to the degree Bachelor of Science is described in College of Education, Curricula.

The industrial education curriculum provides essential preparation for those who have a strong aptitude and interest in industrial education and related fields. The individual is afforded the opportunity to pursue a program leading to a position in industry or to certification to teach in junior and senior high schools. In the latter instance, the student must apply for admission to the teacher education program and be approved by the teacher education committee in industrial education and the Academic Standards Committee, College of Education. For admission and certification requirements, see College of Education.

Safety and Driver Education. Students interested in obtaining a certificate to teach Safety and Driver Education in secondary schools will enroll in those courses in industrial education designed to meet approval requirements. For the list of those courses, see College of Education, Curricula.

Graduate Study

Industrial education offers work for the degrees Master of Science, Master of Education, and Doctor of Philosophy in education with major in industrial education, and minor work for students taking major work in other departments. Within the industrial education major, a student may specialize in vocational-technical education or industrial arts.

Prerequisite to major graduate work is preparation substantively equivalent to the completion of the undergraduate curriculum in industrial education and adequate proof that the student ranks above average in scholastic ability and promise of professional competency.

There is no language requirement for the degrees Master of Science or Master of Education. A satisfactory reading knowledge of two languages selected from French, German, Russian, or Spanish is required of doctoral candidates. At the discretion of the student's graduate program committee, the foreign language requirement may be met by: (1) demonstrating a satisfactory reading knowledge of two of the languages named; (2) demonstrating a significantly higher degree of competence in one of the named languages; (3) substituting two years of undergraduate study in the language with a B average for one of the above languages; or (4) substituting 9 quarter credits of graduate work in addition to the minimum Ph.D. requirements in approved areas for one language or 18 credits for two languages. Students whose native language is not English may substitute competence in English for one of the languages.

COURSE FOR NONCOLLEGIATE STUDENTS

18. DRIVER EDUCATION. (0-2) Cr. 0. F.W.S.S.

For those learning to drive an automobile. See Fees and Expenses.

COURSES PRIMARILY FOR UNDERGRADUATE STUDENTS

105. TECHNOLOGY AND APPLICATION OF FINISHING MATERIALS. (2-4) Cr. 3. F.

A technical approach to finishing materials and techniques used in schools and industries. Testing and evaluating finishes, experimentation, and introductory research.
106. EXPLORATION AND FUNDAMENTAL FABRICATION OF WOOD.
(2-4) Cr. 3. W.
Prerequisite: 105.
Introduction to hand tools, basic machines, pattern making, home construction, and wood technology in current practice.

110. INTRODUCTION TO INDUSTRIAL EDUCATION.
(3-0) Cr. 3. F.W.S.
Qualification, opportunities, preparation, and duties of workers in industrial arts, vocational industrial education, and industry.

121. DRAFTING I.
(2-4) Cr. 3. F.W.
Lettering; principles and fundamentals of drafting, including techniques, care and use of equipment, sketching, orthographic projection, pictorial drawing, drawing reproduction, topographical drawing, and architectural drafting.

122. DRAFTING II.
(2-4) Cr. 3. W.S.
Prerequisite: 121.
Continuation of I. Ed. 121. Emphasis on detail and assembly drawing, fasteners, dimensioning, and surface development.

123. DRAFTING III.
(2-4) Cr. 3. F.S.
Prerequisite: 122.
This course is a continuation of I. Ed. 122. Emphasis on machine drafting, rendering, basic tool design, and an introduction to electrical drafting.

205. ADVANCED TECHNIQUES OF WOOD FABRICATION.
(2-4) Cr. 3. S.SSI.
Prerequisite: 106.
Basic principles and practices involved in the use of power woodworking machines and their application to furniture and cabinetry making.

216. PROBLEMS OF HUMAN CONSERVATION.
(3-0) Cr. 3. F.
Prerequisite: Psych. 101.
Survey of highway, industrial, farm and home safety, and safety organizations. Principles of accident prevention, individual and group responsibilities.

220. INDUSTRIAL ARTS DESIGN.
(3-0) Cr. 3. F.S.
Application of fundamental principles of design to the field of industrial education. Principles of design, design evaluation, redesign of existing articles, designing for industrial education activities.

230. ORNAMENTAL METAL DESIGN AND PROCESSES.
(0-6) Cr. 3. W.
Principles and practices involved in the use of ferrous and nonferrous metals for construction of ornamental projects and teaching aids. Such operations as spinning, tooling, etching, annealing, and wrought iron work.

232. SHEET METAL FABRICATION.
(0-6) Cr. 3. F.S.
Principles and practices involved in the use of sheet metal tools, equipment and materials, forming and fabrication, layout techniques.

234. BASIC METAL PROCESSES.
(0-6) Cr. 3. F.W.S.
Principles and practices of bench metalwork; layout, sawing, chiseling, filing, drilling; threading, hardening, tempering, casting.

238. MACHINE METALS I.
(2-4) Cr. 3. F.W.S.
Prerequisite: 234.
General machine tool operation. Emphasis on precision measuring instruments and technical information as applied to industrial education.

240. CRAFTS.
(0-6) Cr. 3. W.
Craft materials and their application to industrial arts and shopwork, principles and techniques of crafts suitable for industrial art craft classes, such as plastics, leather, gem cutting.

251. ELECTRICITY I.
(0-6) Cr. 3. F.W.
Fundamental principles and practices in teaching of direct current electricity in industrial education. The development of experiments, projects, and teaching aids for the secondary school industrial education electricity program.

253. ELECTRICITY II.
(0-6) Cr. 3. F.W.S.S.
Prerequisite: 251.
Fundamental principles and practices in the teaching of alternating current electricity in industrial education. Practical problems in power distribution and use of test equipment. The development of experiments, projects, and teaching aids for the secondary school industrial education electricity program.

260. POWER MECHANICS: AN INTRODUCTION.
(3-0) Cr. 3. F.W.S.S.
A brief study of the sources of power, application of power, power-producing and control devices, research and development of power.

261. POWER MECHANICS: INTERNAL COMBUSTION ENGINES.
(2-4) Cr. 3. F.W.S.S.
Prerequisite: 260.
Familiarization with reciprocating and reaction engines with emphasis on two- and four-stroke cycle reciprocating engines. Use of tools and equipment for small engine overhaul and tune-up.

262. POWER MECHANICS: THE AUTOMOBILE.
(3-0) Cr. 3. F.W.S.S.
Prerequisite: 261.
General introduction to the automotive production and service industry, and the automobile itself including engine, chassis, and body.

308. MODERN MATERIALS: DESIGN AND CONSTRUCTION.
(0-6) Cr. 3. F.W.
Prerequisite: 105, 106, 205.
Advanced design and construction as applied to furniture, cabinet making, sporting equipment, and specialized items.

310. SCHOOL LABORATORY SAFETY.
(3-0) Cr. 3. F.S.
Prerequisite: Junior classification.
Analysis of accidents and accident prevention in the secondary school industrial education laboratory. Methods of initiating an effective safety program.

316. THEORY AND PRINCIPLES OF DRIVER EDUCATION.
(3-4) Cr. 5. W.
Prerequisite: 216, Iowa driver's license, permission of instructor. Source material: methods, policies and procedures, and psychological aspects of driver education; techniques including psychophysical measurement and interpretation.

317. PRACTICES OF DRIVER EDUCATION.
Cr. 1 to 2 each time elected, no more than 4 total.
Prerequisite: 316, Iowa driver's license, permission of instructor. Organization of, and experience with, both classroom and behind-the-wheel phases of driver education, including range, lesson plans, films, scheduling and testing techniques.
324. ARCHITECTURAL DRAFTING FOR INDUSTRIAL EDUCATION TEACHERS. (2-4) Cr. 3. S.
Prerequisite: Nine credits in drafting.
DRAFTING TECHNIQUES REPRESENTING THE VARIOUS ASPECTS OF CONSTRUCTION PLANS. CONTENT IS DIRECTED TO THE TEACHING OF SECONDARY AND POST-HIGH SCHOOL ARCHITECTURAL DRAFTING COURSES.

336. MACHINE METALS II. (2-4) Cr. 3. F.W.S.
Prerequisite: 236.
GENERAL MACHINE TOOL OPERATION WITH EMPHASIS ON ADVANCED SET-UPS ON MACHINE TOOLS, INCLUDING PRECISION GRINDING AND MEASUREMENTS. RELATED TECHNICAL INFORMATION AS APPLIED TO THE ADVANCED OPERATIONS AND SETUPS.

352. ELECTRICITY III. (0-6) Cr. 3. W.
Prerequisite: 253.
BASIC PRINCIPLES AND PRACTICES INVOLVED IN ELECTRIC MACHINES AND APPLIANCES AS APPLIED TO THE SECONDARY SCHOOL ELECTRICITY LABORATORY WORK.

357. ELECTRONICS I. (0-6) Cr. 3. F.S.
Prerequisite: 253.
BASIC PRINCIPLES OF RADIO CONSTRUCTION, SERVICE, AND REPAIR AS APPLIED TO THE SECONDARY SCHOOL INDUSTRIAL EDUCATION ELECTRONICS PROGRAM. USE OF THE OSCILLOSCOPE, SIGNAL GENERATOR, SIGNAL TRACER, AND OTHER TEST EQUIPMENT IN RADIO.

361. POWER MECHANICS: ENGINE OVERHAUL PROCEDURES. (0-6) Cr. 3. F.W.S.
Prerequisite: 262.
AUTOMOBILE ENGINE OVERHAUL PROCEDURES AND TECHNIQUES, INCLUDING PROPER USE OF TOOLS, EQUIPMENT, AND MANUFACTURERS' BASES; ADJUSTMENTS AND MEASUREMENTS; DEVELOPMENT OF SUPPLEMENTARY INSTRUCTIONAL MATERIALS.

364. POWER MECHANICS: SUSPENSION AND BRAKING SYSTEMS. (0-6) Cr. 3. F.W.S.
Prerequisite: 262.
A STUDY OF AUTOMOBILE SUSPENSION, BRAKING, AND POWER TRANSMISSION SYSTEMS; FAMILIARIZATION BY WORK ON REPRESENTATIVE MODELS.

368. POWER MECHANICS: TUNE-UP AND ELECTRICAL SERVICE. (0-6) Cr. 3. F.W.S.
Prerequisite: 262.
AUTOMOBILE ENGINE TUNE-UP AND ELECTRICAL SERVICE. THEORY OF THE AUTOMOBILE ELECTRICAL AND FUEL SYSTEMS. APPLICATION OF THEORY IN TROUBLESHOOTING AND REPAIRING. DEVELOPING AND PRESENTING INSTRUCTIONAL MATERIALS AND TECHNIQUES.

370. INTRODUCTION TO INDUSTRIAL PLASTICS. (0-6) Cr. 3. F.W.S.
Prerequisite: 106; Chem. 140 and 140L, or 141 and 141L.
TECHNOLOGY OF PLASTIC MATERIALS AND PRODUCTION PROCESSES. PRINCIPLES OF THERMOFORMING, COMPRESSION, TRANSFER, INJECTION, AND ROTATIONAL MOLDING.

390. CARE OF EQUIPMENT. (0-6) Cr. 2. F.W.S.
Prerequisite: Industrial education major, junior standing.
TECHNIQUES AND METHODS INVOLVED IN MAINTENANCE AND REPAIR OF SHOP TOOLS AND MACHINERY.

400. COOPERATIVE WORK EXPERIENCE. Cr. R; REQUIRED OF INDUSTRIAL EDUCATION COOPERATIVE STUDENTS.

Prerequisite: Permission of department head. Students must register for this course prior to beginning each period of work.

410. FACILITY PLANNING AND ORGANIZATION. (3-0) Cr. 3. S.
PLANNING OF INDUSTRIAL EDUCATION LABORATORIES AND CLASSROOMS, SELECTION AND LOCATION OF EQUIPMENT, COST ESTIMATING, SPATIAL RELATIONSHIPS.

415. METHODS OF TEACHING INDUSTRIAL ARTS. (5-0) Cr. 3. S.
Prerequisite: Educ. 305A.
METHODS AND TECHNIQUES OF TEACHING INDUSTRIAL ARTS; OBJECTIVES, ORGANIZATION OF SUBJECT MATTER, RELATIONSHIPS, AND EVALUATION. FIELD TRIPS TO SCHOOLS AND TEACHING LABORATORY EXPERIENCES INCLUDING MICRO-TEACHING.

417. OBSERVATION AND SUPERVISED STUDENT TEACHING IN INDUSTRIAL EDUCATION. Cr. 3 to 12. F.W.S.
Prerequisite: 415.
OBSERVATION AND SUPERVISED TEACHING IN PUBLIC SCHOOLS.

418. MULTIPLE CAR RANGE TECHNIQUES. (0-2 to 6) Cr. 1 to 2 each time taken, maximum of 3 credits. F.W.S.S.
Prerequisite: Three credits in I.ED. 317, permission of instructor, Schwenk.
ORGANIZATION OF AND EXPERIENCE WITH THE MULTIPLE-CAR APPROACH TO TEACHING DRIVER EDUCATION. INTERNSHIP PERIOD ARRANGED WITH HIGH SCHOOL PROGRAMS TO PROVIDE FOR OBSERVATION AND EXPERIENCE UNDER ACTUAL CONDITIONS.

419. SIMULATION TECHNIQUES. (0-2 to 6) Cr. 1 to 2 each time taken, maximum of 3 credits. F.W.S.S.
Prerequisite: Two credits in I.ED. 317, permission of instructor, Schwenk.
ORGANIZATION OF AND EXPERIENCE WITH SIMULATION AS A TEACHING PHASE IN DRIVER EDUCATION. INTERNSHIP PERIOD ARRANGED WITH HIGH SCHOOL PROGRAMS TO PROVIDE FOR OBSERVATION AND EXPERIENCE UNDER ACTUAL CONDITIONS.

450. ELECTRONICS II. (1-6) Cr. 3. F.W.S.
Prerequisite: 357.
BASIC TELEVISION CONSTRUCTION, SERVICE, AND REPAIR. USE OF THE OSCILLOSCOPE, VACUUM TUBE-VOLT-AMMETER, MILLIAMMETER AND OTHER TEST EQUIPMENT USED IN TELEVISION REPAIR. BASIC PRINCIPLES OF TELEVISION AND FREQUENCY MODULATION AS APPLIED TO THE SECONDARY SCHOOL INDUSTRIAL EDUCATION ELECTRONICS PROGRAM.

490. SPECIAL PROBLEMS IN INDUSTRIAL EDUCATION. Cr. 1 to 5.
Prerequisite: Junior classification, quality point average of 2.5 or more for two preceding quarters.
A. Industrial Education.
B. Professional Methods.
C. Curriculum.
D. Drafting, Design, Planning.
E. Electricity-Electronics.
F. Instructional Materials.
G. Technical Training.
H. Honors Program.
M. Metals.
P. Power.
R. Plastics.
S. Safety Education.
T. Safety, Industrial Education.
W. Wood Technology.
501. WOOD COMPOSITION MATERIALS.  
(1-5) Cr. 3. F. SS. SS. offered 1973.  
Prerequisite: 205 or permission of instructor.  
Principles of large-scale production of particle board, hard board, and wood flour-molded products through hot and cold molding method.

510. TECHNIQUE OF TEACHING VOCATIONAL AND TECHNICAL EDUCATION.  
(3-0) Cr. 3. F.W.S.  
Prerequisite: Permission of instructor.  
Teaching processes, methods of presentation and testing, lesson planning and organization of instruction.

514. FOUNDATIONS OF VOCATIONAL AND TECHNICAL EDUCATION.  
(3-0) Cr. 3. F.W.S.  
Prerequisite: Permission of Instructor. Sarchett. Development and philosophy of vocational-technical education, federal and state legislation. State plans, divisions and types of programs.

516. TRENDS IN VOCATIONAL-TECHNICAL EDUCATION.  
(3-0) Cr. 3. SS.  
Prerequisite: Permission of instructor.  
Brief review of the development of vocational and technical education. A study of the most recent trends in various types of schools offering vocational-technical education with respect to curriculum, qualifications and training of instructors, administration of program, requirements for program certification, and the developing ratio of technical, related, and general education within the curriculum.

518. PROBLEMS IN INDUSTRIAL EDUCATION.  
(3-0) Cr. 3. SS.  
Prerequisite: 415.  
Initiating programs, program organization and development, purchasing materials, supplies, and equipment; facility planning and utilization; writing specifications; program evaluation; and other related problems.

519. OCCUPATIONAL ANALYSIS AND COURSE CONSTRUCTION.  
(3-0) Cr. 3. F.W.S.  
Prerequisite: Permission of instructor.  
Course of study development based on occupational analysis, compilation, arrangement, and limitations of instructional materials.

524. CONFERENCE-LEADING TECHNIQUES.  
(6-0) Cr. 3. SS.  
Prerequisite: Permission of instructor.  
Study and practice of conference procedures and techniques as applied to teaching and advisory committee functions.

525. COORDINATION OF PART-TIME COOPERATIVE INDUSTRIAL EDUCATION.  
(3-0) Cr. 3. SS.  
Prerequisite: 514.  
Planning and cooperating with business and industry to provide part-time on-the-job training for high school student learners.

528. PUBLIC RELATIONS FOR INDUSTRIAL AND TECHNICAL EDUCATION.  
(3-0) Cr. 3. SS.  
Prerequisite: 514.  
Identifying a plan of public relations for industrial and technical education; analysis of publicity that need to be reached; effect of human relations on public relations; criteria for evaluation.

554. DEVELOPMENT OF INDUSTRIAL EDUCATION.  
(3-0) Cr. 3. SS.  
An evaluation of educational and industrial thought. Historical and philosophical development of industrial education to the present. Trends and implications.

555. ADMINISTRATION AND SUPERVISION OF INDUSTRIAL EDUCATION.  
(3-0) Cr. 2 or 3. SS.  
Prerequisite: Permission of instructor. Carver. Administration, supervision, curriculum development, selection of staff, and public relations. Evaluating administrative and supervisory efforts; program modification. Field trips to schools and industries.

556. CURRENT ISSUES AND MODERN CONCEPTS IN INDUSTRIAL EDUCATION.  
(3-0) Cr. 3.  
Prerequisite: Fifteen credits in industrial education. Carver, Parks.  
A critical analysis of industrial education in the evolving role of education. Newer concepts of teaching laboratory work; impact of research and experimentation; implications for curriculum change and program modernization.

557. ORGANIZATION AND MANAGEMENT OF THE INDUSTRIAL EDUCATION LABORATORY.  
(3-0) Cr. 3. SS.  
Prerequisite: Fifteen credits in industrial education. Carver, Parks.  
Principles and practices involved in the planning, organization, and management of the school shop; responsibility of the school administrator and teacher; basic principles of planning; selection and purchase of machines, tools, equipment, and materials; maintenance, storage, and control of machines, tools, and equipment; managing the shop for effective work.

559. PROCESSES AND SYSTEMS IN AMERICAN INDUSTRY.  
(3-0) Cr. 3. SS.  
Prerequisite: Permission of instructor.  
An exploratory study of modern manufacturing industries. Designed to prepare teachers to interpret industry through a better understanding of the facets; management, systems, controls, financing, and personnel.

570. ADMINISTRATION OF ACCIDENT PREVENTION PROGRAMS.  
(3-0) Cr. 3. SS.  
Prerequisite: 216, 316.  
Effective methods of developing the background and motivation essential to accident prevention at various educational levels.

571. SEMINAR: PSYCHOLOGY OF SAFETY.  
(2-0) Cr. 1. SS.  
Prerequisite: Nine credits in psychology and education, permission of instructor. Schwenk.  
Review of literature in field of safety. Roundtable discussions with state and national safety experts and public officials.

590. SPECIAL TOPICS IN INDUSTRIAL EDUCATION.  
Cr. to 5.  
Prerequisite: Graduate classification in industrial education.  
A. Industrial Arts.  
B. Vocational-Technical.  
C. Curriculum.  
D. Evaluation.  
E. Administration and Supervision.  
F. Instructional Materials.  
G. History and Philosophy.  
J. Research.  
K. Laboratory Problems.  
L. Technical Training.  
S. Safety Education.  
T. Safety, Industrial Education.

593F. WORKSHOP IN INDUSTRIAL EDUCATION.  
Cr. I to 5. SS.  
Prerequisite: Fifteen credits in industrial education. Carver, Parks, Wolansky.
COURSES FOR GRADUATE STUDENTS, major or minor

615. SEMINAR.
Cr. 1 to 3. F.W.S.S.
Prerequisite: Permission of Instructor.

652. EVALUATION IN INDUSTRIAL EDUCATION.
(2 or 3-0) Cr. 2 or 3. SS.
Prerequisite: Fifteen credits in industrial education. Carver, Stephens.
Developing basic concepts. Techniques for evaluating student personnel, facilities, programs, staff, and other educational resources.

656. INSTRUCTIONAL MATERIALS FOR INDUSTRIAL EDUCATION.
(3-0) Cr. 3. SS.
Prerequisite: Fifteen credits in industrial education. Carver, Parks.
Examination or new equipment, materials, and techniques in using instructional materials in industrial education teaching.

657. CURRICULUM DEVELOPMENT IN INDUSTRIAL EDUCATION.
(3-0) Cr. 3. SS.
Prerequisite: Fifteen credits in industrial education. Carver.
Basic concepts, trends, practices, and factors influencing curriculum development; techniques, organization, and procedures; the course of study and its development in a given curriculum pattern.

699. RESEARCH.

INDUSTRIAL ENGINEERING
Joseph K. Walkup, B.M.E., I.E., Head of Department


Assistant Professors: Raymond A. Denison, B.Sc.; Donald E. Grant, B.S.; Herbert A. Harmison, Jr., M.S.; George E. Lamp, Ph.D.; Robert D. Love, M.S.; Howard D. Meeks, Ph.D.; Loran E. Mohr, M.S.; John G. Sainick, M.B.A.

Instructors: Richard D. Chartier, B.S.; Harold M. Hoover, Jr., M.S.; Edwin L. Hullander, M.S.; Raymond E. Stanley, B.S.

Undergraduate Study
For undergraduate curriculum in industrial engineering leading to the degree Bachelor of Science, see College of Engineering, Curricula.

The industrial engineering curriculum affords essential training to those who have strong aptitude and interest in engineering and a potential capacity for management. An industrial engineer is concerned with the design, improvement, and installation of integrated systems of men, materials, and equipment; drawing upon specialized knowledge and skill in the mathematical, physical, and social sciences together with the principles and methods of engineering analysis and design, to specify, predict and evaluate the results to be obtained from such systems. The professional services performed by industrial engineers include plant layout and design, methods planning, work measurement, quality control, production control, cost analysis, sales engineering, personnel supervision and management. These services are rendered in fields including all types of manufacturing industries, service industries, distribution organizations and governmental service.

The curriculum includes in addition to the fundamental engineering sciences, a carefully selected sequence of courses in electrical engineering, mechanical engineering, mechanics, industrial administration, and industrial engineering. Limited opportunities through elective courses are available for further study in other fields of engineering or management.

A five-year cooperative work-study program is available in the Industrial Engineering Department. See Cooperative Programs, College of Engineering.

Graduate Study
The department offers work for the degree Master of Engineering and Master of Science with majors in industrial engineering and in engineering valuation, and for the degree Doctor
of Philosophy with major in engineering valuation, and minor work to students taking work in other departments.

Prerequisite to major graduate work is the completion of a curriculum substantially equivalent to that required of undergraduate students in engineering at this institution.

Competence in a foreign language is required for the Master of Science and the Doctor of Philosophy degrees. (A score of 400 in the Educational Testing Service examination in French, German, Italian, Russian, or Spanish meets this requirement.) For the Master of Science degree the candidate's committee may recommend the substitution of an alternative tool of research for the language requirement. Normally, this will be six credits of mathematics, statistics, or computer science courses available for graduate credit, minor only. There is no foreign language requirement for the degree Master of Engineering.

Open to graduate students for minor credit only: 312, 313, 361, 404, 407, 416, 421, 423, 424, 425, 426, 441, 442, 443, 448, 462, 475.

COURSES PRIMARILY FOR UNDERGRADUATE STUDENTS

100. TECHNICAL LECTURE.
(1-0) Cr. R; S.
Lectures and conferences designed to aid the freshman student to adjust himself both in his course and in college environments.

104. ENGINEERING PROBLEMS.
(1-2) Cr. 1. F.W.
Applications of algebra; development of computing skills and orderly methods of solving problems; engineering forms and standards. Uses of slide rule, logarithms, graphs, and tables.

105. ENGINEERING PROBLEMS.
(1-2) Cr. 1. W.S.
Prerequisite: 104.
Development of skills and orderly methods of solving problems involving computations of an engineering character. Basic calculating techniques; longhand, slide rule, and logarithms. Application of trigonometry and background mathematics to the solution of engineering problems.

108. METHODS OF ENGINEERING COMPUTATIONS.
(0-3) Cr. 1. F.W.
Prerequisite: Credit or classification in Math. 109.
Training in skills, standards, and methods essential for engineering computations.

109. INTRODUCTION TO DIGITAL COMPUTERS.
(1-1 or 0-3) Cr. 1. F.W.S.
Prerequisite: Three credits of mathematics. Engineering students required to have credit in 105 or 108.
Elementary programming techniques including the use of interpretive routines. Fundamentals in and appreciation of high-speed electronic digital computers including laboratory exercises on the computing center equipment.

250. INTRODUCTION TO INDUSTRIAL ENGINEERING.
(4-0) Cr. 4. F.W.S.
Growth, development, ownership, organization, management, and control of industrial structures. Relation of the industrial engineer to his industrial environment. Introduction to the functional activities of industrial engineering.

273. METHODS ENGINEERING AND WORK MEASUREMENT.
(3-2) Cr. 4. W.S.
Prerequisite: 250.
Principles and practice in motion economy, time-study and other approaches to work measurement; micromotion analysis, memomotion, and random filming techniques. Consideration of human factors and economic factors in methods engineering and work-center design, work simplification, and production system development. Introduction to standard data and predetermined standard times.

293. SEMINAR.
(1-0) Cr. R; F.W.S.
Required of all third-quarter sophomore students. Required of senior college transfer students in the first quarter after transfer to the Industrial Engineering Department. May be taken concurrently with 391.

304. ANALYSIS FOR ENGINEERING ECONOMY.
(3-0) Cr. 3. F.W.S.
Derivation of formulas used in theory of investment of engineering enterprises, economy studies applied to original and alternative investments in engineering, replacement problems, relationship to accounting.

312, 313. INDUSTRIAL OPERATIONS RESEARCH.
(4-0) Cr. 4 each. 312: F.W; 313: W.S.
Prerequisite: 312: Math. 205; 313: 312, Stat. 341.
History and growth of operations research. The development of mathematical concepts and models concerned with engineering and management decisions. Single and multi-variate optimization models, e.g., linear programming, inventory theory, game theory, network analysis theory, and other deterministic and stochastic models.

351. INDUSTRIAL ORGANIZATION.
(3-0) Cr. 3. F.W.S.
Prerequisite: Junior classification.
Industrial tendencies, ownership, types of organization; the principles and methods of production control, inspection, motion and time study, wage systems, cost control and personnel relations in the coordination of an industrial organization.

361. QUANTITATIVE METHODS FOR INDUSTRIAL ENGINEERING.
(3-0) Cr. 3. F.W.S.
Prerequisite: 250 or 361; Stat. 342.
Adaptation and application of mathematical and statistical techniques to the analysis of problems of an engineering nature. Interpretation of the problems in physical terms.

391. SEMINAR.
(1-0) Cr. R; F.

392. SEMINAR.
(1-0) Cr. R; W.
393. INDUSTRIAL INSPECTION TRIP.  
Cr. R; S.  
Prerequisite: Junior industrial engineering classification.  
One week spent in industrial centers visiting and inspecting industrial plants.

395. SUMMER WORK.  
Cr. 3 each.  
Prerequisite: Advance approval of department head.  
Approved summer work in industrial plants not acceptable as an industrial engineering elective or management elective for industrial engineering or engineering operations majors

404. ENGINEERING ECONOMY.  
(2-2 or 3-0) Cr. 3. F.W.S.  
Prerequisite: Econ. 242, I.Ad. 371.  
Application of fundamentals of economics to engineering alternatives in planning, developing, and managing industrial projects.

407. ENGINEERING VALUATION.  
(3-0) Cr. 3. F.W.S.  
Prerequisite: Econ. 241, 3 credits of accounting.  
Concepts of value, original cost, and reproduction cost, property records, methods of estimating depreciation for valuation and accounting; intangible values, cost values, earning values, rate base, and valuation for taxation, rates, financing, insurance, and sales.

416. PRODUCTION ANALYSIS.  
(3-0) Cr. 3. S.  
Prerequisite: 313.  
Specialized mathematical techniques applied to industrial production management.

420. ENGINEERING SALES.  
(3-0) Cr. 3. S.  
Prerequisite: 304, 480.  
Concepts involved with selling technical goods and services. Application of legal, economic, and ethical principles involved in the preparation of specifications, bids, and contracts.

421. SAFETY ENGINEERING.  
(3-0 or 3-3) Cr. 3 or 4. F.S.  
Prerequisite: 250 or 351.  

423. JOB COMPENSATION.  
(2-3) Cr. 3. F.  
Study of the principal pressures and their influence on forms and levels of job compensation.

424, 425. MANPOWER MANAGEMENT.  
Cr. 3 each. 424: (3-0) F.W.; 425: (2-2) W.S.  
Prerequisite: 424: 250 or 351; Psych. 101. 425: 424.  
Employer-employee problems and desirable approaches to their solution based upon the application of the principles and techniques of selection and placement of industrial manpower, personnel management and control, and wage and salary administration.

426. PERSONNEL MANAGEMENT.  
(3-0) Cr. 3. S.  
Prerequisite: 425.  
Advanced study of modern personnel management techniques which influence the design of company organization, policies, and the resulting practices and procedures. Employer instruction, training, education, and evaluation emphasized.

441. INDUSTRIAL ENGINEERING DESIGN I.  
(3-4) Cr. 6. F.W.  
Prerequisite: 273, 312, 404.  

442. INDUSTRIAL ENGINEERING DESIGN II.  
(3-4) Cr. 5. W.S.  
Prerequisite: 313, 441.  
The development of organization charts and standard crews; the determination and the design of records of performance to be used in the administrative control of a typical manufacturing enterprise.

443. INDUSTRIAL ENGINEERING DESIGN III.  
(2-2) Cr. 3. S.  
Prerequisite: Credit or classification in 442.  
The development and application of inventory records, load charts, production orders, schedules, production reports, progress reports and control reports to a manufacturing problem in such a manner as to keep a continuous comparison between planned and actual results.

448. INDUSTRIAL DYNAMICS.  
(1-0) Cr. 3.  
Prerequisite: 351, 404.  
Information-feedback characteristics of industrial systems; interaction of organization structure, policies, and time delays in the success of an enterprise; relationships between flow of information, money, materials, orders, personnel, and capital equipment in an organization or industry. Model building and computer simulation are utilized.

462. ENGINEERING INSPECTION.  
(3-0) Cr. 3. S.  
Prerequisite: 250 or 351; Stat. 105.  
Inspection of department functions and organization, quality-control procedures, acceptance sampling, and cost studies.

475. MOTION AND TIME STUDY.  
(2-3) Cr. 3. W.S.  
Prerequisite: 351.  
Principles and methods of motion and time study as employed in industrial operations.

480. ENGINEERING CONTRACTS.  
(3-0) Cr. 3. F.W.S.  
Prerequisite: Junior classification.  
Engineer in business; contract essentials and principles; agent and independent contractor; contracts involving real and personal property, sale and transportation; corporation engineering; legal and equitable jurisprudence.

490. SPECIAL PROBLEMS.  
Cr. 1 to 5.  
Prerequisite: Senior classification, permission of department head.  
Formulation and solution of theoretical or practical problems which relate to manufacturing, public utilities, operation of communication systems, or other industrial methods. H. Honors.

492. SEMINAR.  
(1-0) Cr. R; W.  

COURSES PRIMARILY FOR GRADUATE STUDENTS, major or minor, open to qualified undergraduates.

504. ADVANCED ENGINEERING ECONOMY.  
Cr. 3 to 5. F.W.S.  
Prerequisite: 404.  
Advanced engineering economic analysis; engineering, financial and intangible factors influencing management decision for expenditure of funds. Applications of capital recovery and physical plant replacement theories.
412 Courses and Programs

505. CAPITAL EXPENDITURE PROGRAMMING. 
(3-0) Cr. 3. F. 
Prerequisite: 504. 
Determination of capital expenditure policy and budget. Factors influencing the priority queue (urgency) and the optimum-ratied level of expenditures. Project request, consideration, revision, screening, rejection, postponement, approval, subsequent verification, and feedback processes. Planning and control of the capital expenditure budget and sources of funds.

506. ENGINEERING ASPECTS OF PUBLIC UTILITY ADMINISTRATION. 
Cr. 2 to 5 each time elected. F. 
Prerequisite: 404, 407. 
Engineering problems arising from the regulation of service and rates, the taxation, and the operation of public utilities.

507. DEPRECIATION ESTIMATES. 
(3-0) Cr. 3. W.S. 
Prerequisite: 407. 
Collection and analysis of retirement data. Techniques required for the construction of survivor, probable life, condition percent, and accrued depreciation curves for property groups. Analysis of the effect of growing, declining, and stable properties on depreciation estimates.

509. ENGINEERING VALUATION PRACTICE. 
(2-3) Cr. 3. F.S. 
Prerequisite: 407. 
Application of principles of engineering valuation, including field work, preparation and pricing of inventories, valuations for utility rates, security regulations, condemnations, sales, estate settlements, and determining fixed capital costs.

511. OPERATIONS-RESEARCH CONCEPTS. 
(4-0) Cr. 4. F. 
Prerequisite: 304, Math. 213, Stat. 341. 
Theory and development of operations-research concepts and techniques within industrial contexts. Includes linear programming, dynamic programming, queuing theory, and simulation.

512. QUEUEING THEORY AND APPLICATIONS. 
(3-0) Cr. 3. S. 
Prerequisite: 511. 
Development and use of mathematical models for the analysis of queueing systems as applied primarily to industrial situations. Steady state as well as transient systems are considered.

515. MANAGEMENT SCIENCE I. 
(3-0) Cr. 3. W. 
Prerequisite: 313. 
Development of scientific models and analogies applicable to engineering management; investigation of existing mathematical methods; operations research.

516. MANAGEMENT SCIENCE II. 
(3-0) Cr. 3. S. 
Prerequisite: 515. 
Case studies and industrial problems. New methods and theories in management science and operations research.

522. ENGINEERING ASPECTS OF WAGE DETERMINATION. 
(2-3 or 6) Cr. 3 or 4. S. 
Prerequisite: 423. 
Critical survey of wage programs founded on job evaluation; merit rating, wage incentives, basic hourly wage curve, salary classifications, and administrative programs.

531. INDUSTRIAL STATISTICS: PROCESS CONTROL. 
(Stat. 531) See Statistics.

533. INDUSTRIAL STATISTICS: RELIABILITY. 
(Stat. 533) See Statistics.

539. OPERATIONS RESEARCH. 
(Stat 539) See Statistics.

540. OPERATIONS RESEARCH METHODS AND ECONOMIC ANALYSIS. 

545. ADVANCED INDUSTRIAL ENGINEERING DESIGN. 
Cr. 3 to 5 each time elected. F.W.S. 
Prerequisite: 441. 
Planning and controlling the manufacturing plant. Theory of facilities selection and layout, balancing operations and schedules; design of the manufacturing plant; structure of the organization and system. Control techniques, budgets, and realization comparison.

551. INDUSTRIAL ENGINEERING CONCEPTS. 
Cr. 3 to 5. F. 
Prerequisite: 250 or 351; 480, Econ. 242. 
Development in depth of theoretical and practical concepts of current industrial engineering practice.

552. INDUSTRIAL ORGANIZATION THEORY. 
(3-0) Cr. 3. S. 
Prerequisite: 551. 
Examination of theories of organization with the purpose of explaining, predicting, and influencing organization behavior. Requirements for design and control of industrial organizations and their components.

571. THEORY AND PRINCIPLES OF WORK-TIME RELATIONSHIPS. 
(2-3 or 3-6) Cr. 3 or 5. S. 
Prerequisite: 441. 
Evaluation of time-study systems using predetermined elemental time standards; comparison with stop-watch time study. Applications to industrial situation. Analysis of current literature.

581. LEGAL ASPECTS OF ENGINEERING ADMINISTRATION. 
(3-0) Cr. 3. F. 
Prerequisite: 250 or 351, and 480 or I.Ad. 365A. 
Engineering management contacts with public administrators and administrative law.

582. TAXATION ASPECTS OF ENGINEERING ADMINISTRATION. 
(3-0) Cr. 3. W. 
Prerequisite: 581, I.Ad. 371. 
Concepts of advalorem, income, and excise taxes and their effects on industrial operations and policy making.

583. PATENT ASPECTS OF ENGINEERING ADMINISTRATION. 
(3-0) Cr. 3. S. 
Prerequisite: 480 or I.Ad. 365A desirable. 
Management problems concerning patents, trademarks, franchises, copyrights, and royalties.

590. SPECIAL TOPICS. 
Cr. 1 to 5 each time elected. 
A. Management problems in engineering valuation and depreciation. 
B. Management problems in personnel. 
C. Management problems in industrial engineering. 
D. Management problems in regulated industries.
COURSES FOR GRADUATE STUDENTS, major or minor

608. DEPRECIATION ACCOUNTANCY.
Cr. 2 to 6 each time elected. F.S.
Prerequisite: 507.
Unit and group methods of accounting for depreciation; reserve requirements; adjustment of depreciation rates and reserves; classification of accounts, property accounting methods, income tax regulations.

624. FACTORY PERSONNEL.
Cr. 3 to 5. F.W.S.
Prerequisite: 425, 551.
Employment departments: time and wage problems; shop committees; housing conditions, and industrial relations.

681. COURT AND COMMISSION PRACTICE.
Cr. 2 to 6 each time elected. W.S.
Prerequisite: 681A; 681B; 608; 681B; 581.
A. Utility rates, property valuation, and depreciation.
B. Legal relations in industry.

690. SEMINAR.
Cr. R; F.W.S.

699. RESEARCH.
Cr. 1 to 5.
A. Industrial Engineering Research.
B. Engineering Valuation Research.

INDUSTRIAL RELATIONS

Advisory Committee: Edward B. Jakubauskas, Ph.D., Chairman; Harold W. Davey, Ph.D.; Terry L. Dickinson, Ph.D.; Neil A. Palomba, Ph.D.; Robert O. Richards, Jr., Ph.D.; Clifford E. Smith, Ph.D.

Work is offered for the degree Master of Science with major in industrial relations. This is a multidisciplinary degree offered under a cooperative arrangement by the departments of Economics, Industrial Engineering, Political Science, Psychology, and Sociology.

Graduate students in industrial relations usually receive their undergraduate background in economics, industrial (business) administration, Industrial engineering, political science, psychology, or sociology. Admission is not restricted to students from these majors, however. Students entering industrial relations ideally should have a broad background in the social sciences. One such undergraduate program at Iowa State University is the industrial relations program in the distributed studies major of the College of Sciences and Humanities.

The program in industrial relations is regarded as education for both professional practice and scientific inquiry. Through the Industrial Relations Center and its interdisciplinary faculty, facilities and opportunity exist for research of both a fundamental and applied nature on a variety of problems concerned with the world of people at work.

A student majoring in industrial relations will choose a major professor from the graduate faculty of the cooperating departments, who ordinarily will be a member of the industrial relations advisory committee. The student's program of study will be developed with the guidance of a committee nominated by his major professor, approved by the industrial relations advisory committee and appointed by the dean of the Graduate College. The program of study will include course work from three of the disciplines represented in the industrial relations program.

Each student will select two of the five cooperating disciplines (economics, industrial engineering, political science, psychology, and sociology) as a major field. Approximately two-thirds of the student's program (including thesis) will comprise the major field. The remainder of the program will include Statistics 401 and other elective courses. Statistics 402 is strongly recommended.

Normally, candidates for the degree Master of Science are required to complete satisfactorily 45 credits of acceptable graduate work including preparation of a thesis. With the approval of the student's program of study committee, however, candidates may fulfill requirements by completing satisfactorily 54 credits of course work, in which case preparation of a thesis and Statistics 401 are not required. Under this degree program a student will select courses from four of the five cooperating departments. Satisfactory completion of a comprehensive examination is required.

A foreign language is not required.

The verbal and quantitative aptitude tests of the Graduate Record Examination are required of all applicants to the industrial relations program.

Courses appropriate for the Master of Science degree are determined by the student's program of study committee. Recommended courses for graduate students majoring or minoring
Courses and Programs

in industrial relations include: Econ. 441, 445, 590, 591, 592, 593, 594, 595; Psych. 440, 441, 450, 451, 522, 523, 550, 551, 580, 581; Soc. 401, 410, 480, 570, 600, 601, 698A, 698D; I.E. 424, 425, 426, 448, 475, 480, 522, 571, 581, 590, 624; Pol.S. 420, 421, 422, 520. See departmental listings for course descriptions and credits.

INSTITUTION MANAGEMENT

Marjorie M. McKinley, Ph.D., Head of Department

Professor: Grace M. Augustine, Ph.D.
Associate Professor: Geraldine M. Montag, Ph.D.
Assistant Professors: Thomas A. Beattie, M.Ed.; Nancy E. Brown, M.S.; Janice T. Dana, M.S.; Charles F. Frederiksen, M.S.; Doris J. Hittle, M.A.; Grace E. Olsen, M.S.; Thomas E. Walsh, M.A.
Instructor: Donald G. Rose, B.S.

Undergraduate Study

For undergraduate curriculum in institution management leading to the degree Bachelor of Science, see Home Economics, Curricula. For an Associate in Food Service Management, see Technical Institutes, Food Service Management.

The curriculum in institution management provides professional preparation for men and women interested in managerial positions in institution food service or residence administration. The department offers work for the degree Bachelor of Science with majors in college food and housing administration, hotel and restaurant management, or school food service.

The major in college food and housing administration is planned to provide men and women with a general education plus professional preparation for the management of college and university student unions and residence halls. Basic courses in various aspects of administration are supplemented by laboratory experiences.

The major in hotel and restaurant management provides, in addition to a general education, basic work to prepare men and women for supervisory and executive positions in the hotel and restaurant industry. Principles of business management are presented, as well as fundamentals of food service and housing service.

The major in school food service offers preparation for administering school food service programs in elementary and secondary schools. A general education and basic professional courses pertinent to this field are provided for students who wish to prepare for managing single or multiple school food service systems and to become area and state school food service supervisors or directors. See discussion of institution management curriculum for statement regarding certification for teaching home economics.

Training in large quantity food preparation and service is afforded through the Institution Management Tearoom. The food and house administration departments of the Memorial Union, University residence halls, and other approved establishments offer managerial experience to advanced students. A two- or three-day field trip to businesses related to institution management will be offered alternate years and will be required of majors in the institution management department.

The Technical Institute in Food Service Management is available. Six quarters of university study are combined with one summer of approved food service work experience to qualify a graduate as an Associate in Food Service Management. For detailed information concerning the Technical Institute program, see Technical Institutes, Food Service Management.

Graduate Study

The department offers work for the degree Master of Science with major in institution management and minor work to students taking major work in other departments.

Work may be taken for the degree Doctor of Philosophy as a joint major with depart-
ments offering work for this degree in home economics, engineering, economics, or other related areas.

The usual prerequisite to major graduate work is the completion of 10 quarter credits in institution management and six in food and nutrition, and fundamental preparation in accounting, chemistry, and bacteriology. The exact requirements will depend upon the field of work the student expects to pursue.

There is no foreign language requirement for the degree Master of Science. A foreign language is not required for the degree Doctor of Philosophy unless skill in a particular foreign language is needed in an individual program of study.

Open to graduate students for minor credit only: 450, 460, 470, 484, 485, 487, 488, 489, 490.

COURSES PRIMARILY FOR UNDERGRADUATE STUDENTS

287. INTRODUCTION TO INSTITUTION MANAGEMENT.
(3-0) Cr. 3. S.
Introduction to management concepts and principles as related to general and business use. Orientation to the food and housing service industries. Field trips required.

380. QUANTITY FOOD PRODUCTION MANAGEMENT.
(2-0) Cr. 4. F.W., S.S.S.
Prerequisite: F.&N. 208 or 214.
Principles and application of management in quantity food production, use of appropriate production and service methods and institution equipment. Field trips required.

400. STUDY TOUR.
Prerequisite: Junior or senior institution management classification.
Study tour of quantity food service and house administration units and related industries.

404. SEMINAR.
(2-0) Cr. 2. S.
Prerequisite: Senior classification.

450. HOTEL AND RESTAURANT ACCOUNTING.
(3-0) Cr. 3. Alt. S. offered 1972.
Prerequisite: 451, 452, or 454.
Accounting procedures applicable to hotels and restaurants. Uniform systems of accounts for hotels and restaurants.

460. LEGAL ASPECTS OF HOTEL AND RESTAURANT MANAGEMENT.
(3-0) Cr. 3. Alt. S. offered 1973.
Prerequisite: 467, 1.A. or 386.
Laws relating to the ownership and operation of hotels, restaurants, and similar institutions. The responsibility of management and employees to guests and the public.

470. QUANTITY FOOD PRODUCTION AND SERVICE METHODS.
Cr. arr. S.S. or S.S.S.
Prerequisite: A college course in principles of food production. Methods of producing food in quantity using institution equipment. Interpretation for teaching nonsupervisory food service workers. Designed to contribute to preparation of teachers of vocational food service courses. Not accepted in lieu of 1.Mgt. 380 for Iowa State institution management and food and nutrition majors.

484. PURCHASING AND INVENTORY MANAGEMENT.
(3-3) Cr. 4. F.W.
Prerequisite: 380 or F.&N. 303.
Principles of buying food and inventory management for various types of quantity food service. Emphasis on specifications and various factors affecting quality. Field trips required.

485. LAYOUT AND EQUIPMENT.
(3-3) Cr. 4. S.S.S.
Prerequisite: Credit or classification in 380.
Food facilities planning and design; selection of equipment with emphasis on materials, construction, and specifications. Field trips required.

486. INSTITUTION MANAGEMENT EXPERIENCE.
A: (1 or 2-0) Cr. 1 or 2. W.
B: (0-6 or 9) Cr. 2 or 3. W.
C: (1 or 2-0) Cr. 1 or 2. S.
D: (0-6 or 9) Cr. 2 or 3. S.
Prerequisite: A, B: 484, 485, 488; C: 486A, 486B, 489; C, D only for students majoring in college food and housing administration.

487. ORGANIZATION AND MANAGEMENT.
(3-0) Cr. 3. W.S.S.
Prerequisite: 380.
Functions of management; procedures and controls applicable to food service and housing organizations; emphasis on financial management including control of food, labor, and other variable costs.

488. PERSONNEL MANAGEMENT IN INSTITUTIONS.
(3-0) Cr. 3. F.S.
Prerequisite: 487.
Principles of management and personnel organization as applied to food and housing organizations; principles and practices related to personnel recruitment, selection, training, employer relations, and wage administration. Union and government considerations.

489. HOUSE ADMINISTRATION.
(2-3) Cr. 3. W.
Prerequisite: 485, senior classification.
Management considerations of residence and housekeeping functions in institutions. Selection and maintenance of institutional furnishings and equipment, and supplies. Field trips required.

490. SPECIAL PROBLEMS.
Cr. arr.
Prerequisite: Permission of department head.
A. Quantity Food Production.
B. Organization and Management.
C. General.
D. Housing.
E. Honors.
COURSES PRIMARILY FOR GRADUATE STUDENTS, major or minor, open to qualified undergraduates

500. SHORT COURSE.
Cr. arr.

580. QUANTITY FOOD DEVELOPMENT.
(1-6) Cr. 3. 8.
Prerequisite: 380, F.A.N. 411, permission of department head.
Experimental approach to methods in quantity food production as related to time factor, institution equipment, and proportions of ingredients.

585. CATERING.
(2-6) Cr. 4. F.W. Alt. 891.
Prerequisite: 380, senior classification.

COURSES FOR GRADUATE STUDENTS, major or minor

601, 602. DECISION OPTIMIZATION IN INSTITUTION MANAGEMENT I, II.
(3-0) Cr. 3 each. 601: W; 602: S.
Prerequisite: Nine quarter credits in institution management including I.Mgt. 487, permission of department head. Montag.
Use of quantitative methods of operations research and engineering economy to optimize decisions in institution food and housing service systems.

604. SEMINAR.
Cr. arr. F.W S. McKinley, Montag.

608. ADMINISTRATION PROBLEMS.
(1-6) Cr. arr. F.W.S.
Prerequisite: 487. McKinley.
Consideration of advanced administrative problems. Case studies in food service and housing departments of Iowa State University, Memorial Union, and other institutions.

699. RESEARCH.

INTERNATIONAL STUDIES

Advisory Committee: Barbara J. Teters, Ph.D., Chairman; William H. Abraham, Ph.D.; Julia F. Anderson, M.S.; H.C. Chang, Ph.D.; Karl H. Friederich, M.S.; David M. Gradwohl, Ph.D.; Richard N. Kottman, Ph.D.; Leslie Miller, M.S.; Osvaldo N. Soto, Dr. en D.; Dennis R. Starleaf, Ph.D.; Rolf H.W. Theen, Ph.D.; Louis M. Thompson, Ph.D.

The international studies programs are designed for students who are interested in international studies as a field of academic study and for those interested in training for employment overseas in the foreign service or other government agencies, in foreign activities of business and industry, or in technical aid and development programs abroad. Students may participate in international studies programs in any one of four colleges: Agriculture, Engineering, Home Economics, or Sciences and Humanities. In the College of Sciences and Humanities, those students majoring in anthropology, economics, foreign languages, history, journalism, philosophy, political science, or sociology may also major in international studies. Students with other major programs may be admitted to the international studies major by the chairman of the international studies committee.

Any student who wishes to enter the program in agriculture, engineering, or home economics must register with the chairman of the international studies committee. The student and his adviser are responsible for stating on the senior requirement sheet that he is completing the program. A member of the international studies committee, representing the student's college, must certify to the registrar that the student has completed the program requirements. The registrar will then enter this fact on the student's transcript. Any student in the College of Sciences and Humanities who wishes to major in international studies must apply to the chairman of the international studies committee who will sign the student's degree program, approving the student's plans for completing the requirements for the international studies major.

For introductory courses on Africa, Latin America, and East Asia, see Distributed Studies.

International Studies in the College of Agriculture

Students in agriculture remain in their chosen curriculum and use their electives to meet program requirements for international studies in agriculture. The requirements are as follows:
### International Studies

**Anthropology**

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
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<tbody>
<tr>
<td>Cultural Anthropology, Anthro 218</td>
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**Economics**

<table>
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<th>Course</th>
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<tr>
<td>Comparative Economic Systems, Econ 306</td>
<td>3</td>
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<tr>
<td>Economics of Underdeveloped Nations, Econ 411</td>
<td>3</td>
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<tr>
<td>International Economics, Econ 455</td>
<td>3</td>
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<tr>
<td>International Finance, Econ 456</td>
<td>3</td>
</tr>
<tr>
<td>Agrarian Reform and Economic Development, Econ 512</td>
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**Foreign Languages**

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<th>Course</th>
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**Political Science**

<table>
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<tr>
<td>Introduction to Comparative Politics, Pol S. 241</td>
<td>3</td>
</tr>
<tr>
<td>Introduction to International Politics, Pol S 251</td>
<td>3</td>
</tr>
<tr>
<td>Politics of Developing Areas, Pol.S. 340</td>
<td>3</td>
</tr>
<tr>
<td>International Law, Pol.S. 422</td>
<td>3</td>
</tr>
<tr>
<td>British and Commonwealth Governments, Pol.S 440</td>
<td>3</td>
</tr>
<tr>
<td>Governments of Western Europe, Pol.S 441</td>
<td>3</td>
</tr>
<tr>
<td>Governments of China and Japan, Pol.S 442A</td>
<td>3</td>
</tr>
<tr>
<td>Governments of India, Pakistan, and Southeast Asia, Pol S 442B</td>
<td>3</td>
</tr>
<tr>
<td>Latin American Governments, Pol.S. 443A</td>
<td>3</td>
</tr>
<tr>
<td>Recent Latin American Politics, Pol.S 443B</td>
<td>3</td>
</tr>
<tr>
<td>Government and Politics of the Soviet Union, Pol S 444</td>
<td>3</td>
</tr>
<tr>
<td>Politics of the Middle East, Pol.S. 445</td>
<td>3</td>
</tr>
<tr>
<td>Governments of Africa South of the Sahara, Pol.S 446A, 446B</td>
<td>3 (each)</td>
</tr>
<tr>
<td>Asia in World Affairs, Pol S 451</td>
<td>3</td>
</tr>
<tr>
<td>Comparative Foreign Policies, Pol.S 452</td>
<td>3</td>
</tr>
<tr>
<td>International Organizations, Pol.S. 453</td>
<td>3</td>
</tr>
<tr>
<td>United States Foreign Policy, Pol.S. 458</td>
<td>3</td>
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**World Resources**

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<tr>
<td>Climates of the Continents, Agron. 406</td>
<td>3</td>
</tr>
<tr>
<td>World Soil Resources, Agron 483</td>
<td>2</td>
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<tr>
<td>World Geography, Geog. 201</td>
<td>3</td>
</tr>
<tr>
<td>Economic Geography, Geog. 322</td>
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</tbody>
</table>

Total: 49 credits

Students who participate in the program and who maintain a grade-point average of 2.5 or above will be eligible for a Luther Vinton Rice Estate Scholarship valued at $200 each academic year. Interested students should consult their advisers.

### International Studies in the College of Engineering

Students in the program must meet the following minimum requirements:

**Anthropology**

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cultural Anthropology, Anthro 218</td>
<td>4</td>
</tr>
</tbody>
</table>

**Earth Science**

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>World Geography, Geog 201</td>
<td>3</td>
</tr>
<tr>
<td>Economic Geography, Geog 322</td>
<td>3</td>
</tr>
</tbody>
</table>

Total: 6 credits

**Economics**

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Principles of Economics, Econ. 241, 242</td>
<td>3 (each)</td>
</tr>
<tr>
<td>Comparative Economic Systems, Econ. 306</td>
<td>3</td>
</tr>
<tr>
<td>Economics of Underdeveloped Nations, Econ. 411</td>
<td>3</td>
</tr>
<tr>
<td>International Economics, Econ. 455</td>
<td>3</td>
</tr>
<tr>
<td>International Finance, Econ. 456</td>
<td>3</td>
</tr>
</tbody>
</table>

Total: 9 credits
**Courses and Programs**

Foreign Language....................................................................................................................................................................... 18 credits

All credits must be in a single language.

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>History of China, Hist. 340, 341</td>
<td>3 credits (each)</td>
</tr>
<tr>
<td>History of Latin America, Hist. 350, 351, 352</td>
<td>3 credits (each)</td>
</tr>
<tr>
<td>Contemporary Europe, Hist. 410A, 410B, 410C</td>
<td>3 credits (each)</td>
</tr>
<tr>
<td>History of Russia, Hist. 416A, 416B, 416C</td>
<td>3 credits (each)</td>
</tr>
<tr>
<td>History of Modern Germany, Hist. 517B</td>
<td>3 credits</td>
</tr>
<tr>
<td>History of the United States Foreign Policy, Hist. 477A, 477B, 477C</td>
<td>3 credits (each)</td>
</tr>
<tr>
<td>U.S. Soveil Relations, Hist. 478</td>
<td>3 credits</td>
</tr>
<tr>
<td>Inter-American Relations, Hist. 479A, 479B</td>
<td>3 credits (each)</td>
</tr>
</tbody>
</table>

Political Science....................................................................................................................................................................... 12 credits

(including Pol.S. 215)

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction to Comparative Politics, Pol.S. 241</td>
<td>3 credits</td>
</tr>
<tr>
<td>Introduction to International Politics, Pol.S. 251</td>
<td>3 credits</td>
</tr>
<tr>
<td>Politics of Developing Areas, Pol.S. 340</td>
<td>3 credits</td>
</tr>
<tr>
<td>International Law, Pol.S. 422</td>
<td>3 credits</td>
</tr>
<tr>
<td>British and Commonwealth Governments, Pol.S. 440</td>
<td>3 credits</td>
</tr>
<tr>
<td>Governments of Western Europe, Pol.S. 441</td>
<td>3 credits</td>
</tr>
<tr>
<td>Governments of China and Japan, Pol.S. 442A</td>
<td>3 credits</td>
</tr>
<tr>
<td>Governments of India, Pakistan, and Southeast Asia, Pol.S. 442B</td>
<td>3 credits</td>
</tr>
<tr>
<td>Latin American Governments, Pol.S. 443A</td>
<td>3 credits</td>
</tr>
<tr>
<td>Recent Latin American Politics, Pol.S. 443B</td>
<td>3 credits</td>
</tr>
<tr>
<td>Governments and Politics of the Soviet Union, Pol.S. 444</td>
<td>3 credits</td>
</tr>
<tr>
<td>Politics of the Middle East, Pol.S. 445</td>
<td>3 credits</td>
</tr>
<tr>
<td>Governments of Africa South of the Sahara, Pol.S 446A, 446B</td>
<td>3 credits (each)</td>
</tr>
<tr>
<td>Asia in World Affairs, Pol.S. 451</td>
<td>3 credits</td>
</tr>
<tr>
<td>Comparative Foreign Policies, Pol.S. 452</td>
<td>3 credits</td>
</tr>
<tr>
<td>International Organizations, Pol.S. 453</td>
<td>3 credits</td>
</tr>
<tr>
<td>United States Foreign Policy, Pol.S. 458</td>
<td>3 credits</td>
</tr>
</tbody>
</table>

Total............................................................................................................. 52 credits

Students may substitute up to 9 credits in Distributed Studies 201-209 for 9 credits in any of the courses listed above, with the exception of the foreign language requirement.

**International Studies in the College of Home Economics**

An emphasis in international studies is designed to provide students with a background for participation in government or agency programs, as well as to provide an opportunity to become oriented to national and international affairs as part of the responsibility of citizenship in its broadest sense.

Students in home economics with a concentration in international studies follow a curriculum that includes emphasis in social sciences—history, political science, economics, sociology, anthropology, psychology, and languages—in addition to home economics.

See *Home Economics* for the specific program. Interested students in home economics should consult Julia F. Anderson for further details.

**International Studies Major in the College of Sciences and Humanities**

Students wishing to major in International studies in the College of Sciences and Humanities must have a second major, ordinarily in anthropology, economics, foreign languages, history, journalism, philosophy, political science, or sociology. Students with other major programs may be admitted to the international studies program by the chairman of the International Studies Committee. Students majoring in international studies may then substitute the international studies major for the minor or minors required of students in the College of Sciences
and Humanities. In addition to fulfilling general education requirements and the major requirements in the discipline he has chosen, each student majoring in international studies must complete the following program:

**A. General Courses in International Studies.** Students majoring in anthropology, economics, history, journalism, philosophy, political science, or sociology, must select from the following list four disciplines other than their own and must complete at least 6 credits in each of the four. Foreign language majors must select at least 6 credits in each of four of the following disciplines. Courses offered in completion of this requirement must be chosen from those listed under each discipline.

**Anthropology:**
The Family in Cross-Cultural Perspective, Anthro. 313 (3 credits)
Comparative Studies of World Cultures, Anthro. 321 (3 credits)
Anthropological Perspectives of Religion, Anthro. 340 (3 credits)
Language and Culture, Anthro. 400 (3 credits)
Ethnology of the Old World, Anthro. 424 (3 credits)
Culture Change, Anthro. 425 (3 credits)

**Economics:**
Comparative Economic Systems, Econ. 306 (3 credits)
Economics of Underdeveloped Nations, Econ. 411 (3 credits)
International Economics, Econ. 455 (3 credits)
International Finance, Econ. 456 (3 credits)

**Geography:**
World Geography, Geog. 201 (3 credits)
Economic Geography, Geog. 322 (3 credits)
Cultural Geography—European and American, Geog. 324 (3 credits)
Cultural Geography—African, Asian, Australian and Pacific Islands, Geog. 325 (3 credits)

**History:**
History of the United States Foreign Policy, Hist. 477A, 477B, 477C (3 credits each)

**Journalism and Mass Communication:**
International Communication and the Foreign Press, JI. 440 (3 credits)
Mass Communication in Developing Nations, JI. 545 (3 credits)

**Political Science:**
Introduction to International Politics, Pol.S. 251 (3 credits)
Politics of Developing Areas, Pol.S. 340 (3 credits)
International Law, Pol.S. 422 (3 credits)
Comparative Foreign Policies, Pol.S. 452 (3 credits)
International Organizations, Pol.S. 453 (3 credits)
United States Foreign Policy, Pol.S. 458 (3 credits)

**Sociology:**
Introduction to Social Ecology and Population Studies, Soc. 304 (3 credits)
Social Stratification, Soc. 330 (3 credits)
Societal Change and Development, Soc. 391 (3 credits)
Adoption and Diffusion of Innovations, Soc. 392 (3 credits)
Urban Sociology, Soc. 410 (3 credits)

Total: ........................................................ 24 credits
B. Area Studies. The student must complete at least 6 credits in one of the following groups:

**Africa and the Middle East:**
- Introduction to Africa, D St. 204, 205, 206 (3 credits each)
- Politics of the Middle East, Pol S 445 (3 credits)
- Governments of Africa South of the Sahara, Pol S 446A, 446B (3 credits each)

**Asia:**
- Introduction to East Asia, D St. 207, 208, 209 (3 credits each)
- History of China, Hist 340, 341 (3 credits each)
- Modern Japanese History, Hist. 443 (3 credits)
- Religions of Western Asia, Phil 351 (3 credits)
- Religions of Southern and Southeastern Asia, Phil 352 (3 credits)
- Religions of East Asia, Phil 353 (3 credits)
- Governments of China and Japan, Pol S 442A (3 credits)
- Governments of India, Pakistan and Southeast Asia, Pol S 442B (3 credits)
- Asia in World Affairs, Pol S. 451 (3 credits)
- Japanese Political Thought and Institutions, Pol S 542 (3 credits)

**Latin America:**
- Introduction to Latin America, D St 201, 202, 203 (3 credits each)
- Contemporary Latin American Cultures, Anthro 323 (3 credits)
- Native Peoples of Middle and South America, Anthro 325 (3 credits)
- History of Latin America, Hist. 350, 351, 352 (3 credits each)
- Inter-American Relations, Hist. 479A, 479B (3 credits each)
- Spanish and Ibero-American Civilization, F L 359 (3 credits)
- Introduction to Spanish American Literature, F L 464, 465, 466 (3 credits each)
- Latin American Governments, Pol S. 443A (3 credits)
- Recent Latin American Politics, Pol S 443B (3 credits)

**Russia:**
- Russian Civilization, F L 327, 328, 329 (3 credits each)
- History of Russia, Hist. 416A, 416B, 416C (3 credits each)
- U S-Soviet Relations, Hist. 478 (3 credits)
- Government and Politics of the Soviet Union, Pol S 444 (3 credits)
- Russian Political Thought and Institutions, Pol. S. 544 (3 credits)
- Soviet Foreign Policy, Pol S 556 (3 credits)

**Western Europe:**
- French Civilization, F L 316 (3 credits)
- German Civilization, F L 338 (3 credits)
- Spanish and Ibero-American Civilization, F L 357, 358 (3 credits each)
- Contemporary Europe, Hist. 410A, 410B, 410C (3 credits each)
- History of Modern Germany, Hist. 517B (3 credits)
- British and Commonwealth Government, Pol S. 440 (3 credits)
- Governments of Western Europe, Pol S 441 (3 credits)


C. Language. The student majoring in international studies must complete 30 credits in one language. Twenty-one of these may be applied to Group 7 of the Sciences and Humanities curriculum requirement.


D. Seminar in International Studies. U St. 430 (3 cr.), will be taken during the student's junior or senior year.


JOURNALISM AND MASS COMMUNICATION

James W. Schwartz, M.S., Head of Department


Associate Professors: Merritt Bailey, M.S.; Edmund G. Blinn, M.S.; Richard L. Disney, Jr., B.A.; J.K. Hvistendahl, Ph.D.; Robert C. Johnson, M.S.; William F. Kunerth, M.S.J.

Assistant Professors: C. Gene Bratton, M.S.; Robert L. Crom, Ph.D.; Raymond P. Fassel, M.A.; Karl H. Friederich, M.S.; Susan Menne, M.A.; Jerome L. Nelson, M.A.; LaRue Pollard, M.S.; Paul Yarbrough, Ph.D.

Instructors: Dale E. Boyd, M.S.; James A. Crook, M.A.; Robert D. Greenlee, M.S.; Lorraine Wechsler, M.S., M.A.

Undergraduate Study

The department offers work for the degrees Bachelor of Science and Bachelor of Arts with a major in journalism and mass communication. A number of professional emphases are available to the student: newspaper journalism, magazine journalism, radio-TV journalism, advertising, public relations and public information, international communication, and the teaching of journalism. These programs are worked out with the aid of the student's academic adviser in journalism and vary depending upon the student's background and experience.

Students in journalism and mass communication enroll in one of four colleges of the university, depending on their area of specialty:

- College of Sciences and Humanities (general journalism and science journalism)
- College of Home Economics (home economics journalism)
- College of Agriculture (agricultural journalism)
- College of Engineering (engineering journalism)

With the exception of general journalism, the basic program is combined with a specialty area within a college. Those in general journalism take essentially a liberal arts program, and support their journalism studies with such subjects as literature, history, political science, psychology, sociology, economics, and philosophy. Either one or two minors or a second major in international relations are required in this curriculum.

Those in the science journalism program concentrate on the physical and biological sciences in preparation for careers in science writing. Home economics journalists take concentrations in food and nutrition, textiles and clothing, applied art, family environment, or child development. Agricultural journalists concentrate in animal science, agronomy, agricultural economics, rural sociology, horticulture, food technology, outdoor recreation, or fish and wildlife. Engineering journalists combine their work in journalism with concentrations of engineering subjects. (See appropriate sections of the catalog for specific requirements in these specialty fields.)

All journalism students take a common core of courses in journalism and mass communication. This consists of a minimum of 34 credits of course work in journalism plus 6 credits of nongraded 490J, the professional work requirement. (The 6 hours of 490J are in addition to the minimum number of credits each college requires for graduation.) Course work includes 101, 201, 202, 203, and at least four 300-level courses and three 400-level courses.

Students majoring in other fields who wish to minor in journalism are invited to consult with journalism staff members for a recommended sequence of courses tailored to fit their particular needs and goals.

Graduate Study

The department offers work for the degree of Master of Science with a major in journalism and mass communication, and minor work to students taking major work in other departments.

For major work, a student must have a bachelor's degree in journalism or in a subject...
Courses and Programs

matter area which he wishes to combine professionally with advanced training in journalism and mass communication.

There is no foreign language requirement for the degree Master of Science.

Open to graduate students for minor credit only: 415, 417, 425, 430, 431, 440, 462, 463, 464, 480.

Courses Primarily for Undergraduate Students

101. introduction to mass communication.
(2-0) Cr. 2. F.W.S.SSI.
Communication models and their application to the mass media; the mass communication process; characteristics and responsibilities of the mass media; media-related professional operations.

201, 202, 203. basic reporting, writing, editing.
201: (0-8) Cr. 4. F.W.S.; 202: (0-6) Cr. 3. F.W.S.; 203: (0-8) Cr. 2. F.W.S.
Prerequisite: 201: 101, Engl. 105 or equivalent, some typing proficiency; 202: 201 or equivalent; 203: 202.
Observation, organization, writing, and editing of materials for all mass media, with emphasis on common principles and competencies. Sequence moves from simple data gathering and writing techniques through a variety of experiences to investigative reporting and interpretive writing. The final course consists of daily writing for print and broadcast media.

225. publicity and public relations.
(3-0) Cr. 3. F.W.S.SSI.
Prerequisite: Engl. 105 or equivalent.
Communication fundamentals, gathering and preparing material for mass communication media; use of communication media for public relations purposes. Not available to majors.

226. developing and implementing public information programs.
(3-0) Cr. 3. F.W.S.
Prerequisite: 225.
For minors and nonmajors who will need to communicate via mass media from their various professions. Interviewing and demonstration techniques for broadcast media; newspaper column planning and writing; use of newsletters and direct mail; house organs and trade publications; broadcast information program development.

317. fundamentals of photography.
(2-6) Cr. 4. F.W.S.SSI.
Camera and dark-room techniques. Evaluation of pictures, the picture story, lighting, pictorial composition.

318. laboratory in photojournalism.
(0-6) Cr. 3. B.
Prerequisite: 317 or equivalent.
Opportunity to explore areas of special interest in photography with emphasis on pictorial composition and fine print quality.

319. motion picture techniques.
(Sp. 319) (2-3) Cr. 3. F.S.
Prerequisite: 317 or equivalent.
Basic techniques in shooting, editing, and presenting motion pictures as a means of communication with special stress on the requirements for television.

325. Advertising.
(3-0) Cr. 3. F.W.S.SSI.
Principles of advertising: history; social, economic and legal aspects; basic appeals; servicing advertising accounts. Not open to freshmen.

326. broadcast media advertising.
(3-0) Cr. 3. W.
Prerequisite: 325.
Analysis of broadcast media; preparation of radio and television commercials; time buying.

337. print media advertising.
(3-0) Cr. 3. F.S.
Prerequisite: 325.
Analysis of print media; preparation of newspaper, magazine, direct mail, and outdoor advertising.

338. advertising and public relations campaigns.
(3-0) Cr. 3. W.S.
Prerequisite: 326 or 337.
Development of national and local advertising and public relations campaigns; strategy and planning; media and market selection; audience identification and description; testing effects.

341. editing and editorial practices.
(2-4) Cr. 3. F.S.
Prerequisite: 202 or 226.
Play of news, effects, editing for all media, arrangement and ordering of materials for newspapers, magazines, broadcast media.

342. layout and design of publications.
(2-4) Cr. 3. F.W.S.SSI.
Prerequisite: 101 or 225.
Principles of layout and design of printed matter; copy fitting, type selection, display, illustration; printing processes.

348. informative writing for radio and television.
(Sp. 348) (3-3) Cr. 4. F.
Prerequisite: 101, 225, or permission of instructor.
Writing and planning continuity, talks, interviews, demonstrations, forums and discussions; documentary programs for radio and television. Field trips.

352. radio and television news reporting.
(3-3) Cr. 4. W.
Prerequisite: 203 or 348.
Writing, editing, news gathering, preparation of broadcast news and public affairs programs. Field trips.

360. depth reporting and writing.
(2-4) Cr. 3. F.S.
Prerequisite: 203; 226 or 352.
Reporting and writing in depth on current issues and concerns, with opportunity to develop news features, magazine articles, broadcast documentaries, monographs.

370. editorial planning for magazines.
(3-0) Cr. 3. W.
Prerequisite: 203.
Seminar on the editorial concept and strategy of a magazine for a specific subject matter field; preparation of copy for a sample issue.

400. telecommunicative arts.
(Sp. 400) See Speech and Telecommunicative Arts.
COURSES PRIMARILY FOR GRADUATE STUDENTS, major or minor, open to qualified undergraduates

510. PROCESS AND STRATEGY OF MASS COMMUNICATION RESEARCH.
(4-0) Cr. 4. F.
Prerequisite: Graduate standing or permission of instructor.
Nature of science and the research process. Relationship of theory, hypotheses, and measurement models. Communication research techniques and study analysis.

512. THEORIES OF MASS COMMUNICATION.
(3-0) Cr. 3. W.
Prerequisite: 510 or permission of instructor. Examination of major areas of research activity and theoretic development related to the organization, functions, and effects of mass communication.

515. STRATEGIES OF COMMUNICATION AND PERSUASION.
(3-0) Cr. 3. S.SSI.

462. PRESS FREEDOM, RESPONSIBILITY, AND ETHICS.
(3-0) Cr. 3. F.W.SSI.
Prerequisite: Graduate classification. Philosophic examination of which the concept of freedom of communication in America is based; theory of responsibility assumed by mass communication media as related to freedom and other privileges; ethical problems faced by users of printed and electronic media.

463. RESEARCH METHODS AND JOURNALISM.
(3-0) Cr. 3. F.
Prerequisite: Junior classification. Investigation of the scientific process in the context of reporting and interpreting research results for professional and lay publics.

464. JOURNALISM AND LITERATURE.
(3-0) Cr. 3. F.W.
Prerequisite: Junior classification. A study of renowned magazine and newspaper writers and analysis of their writing styles, use of language and the other factors that led to achievement of permanent places in the history of American journalism and, often, to literary eminence as well.

480. THE TEACHING OF HIGH SCHOOL JOURNALISM.
(3-0) Cr. 3. W.SII.
Prerequisite: Junior classification, admission to teacher education program. Seminar on the techniques of teaching high school journalism coordinate with advising high school publications. For the journalism major preparing for high school teaching and for the nonmajor who could expect a Journalism course assignment as part of his high school teaching program.

490. SPECIAL PROBLEMS IN COMMUNICATIONS.
Cr. arr.
Prerequisite: Permission of instructor.
A. Broadcasting.
B. Visual/Pictorial.
C. Advertising/Public Relations.
D. Media Management.
E. Law.
F. History.
G. International.
H. Honors.
I. Audiences and Effects.
J. Professional Media Work (6 cr. required). On satisfactory-fail grading system.
K. Technology.
530. THE PRESS AND SOCIETY: INTERRELATIONSHIPS.
(3-0) Cr. 3. S.
Prerequisite: Graduate standing or permission of instructor.
The press and its functions in a democratic society; conflicts between the press and social institutions; legal, social, and political controls of the press; solutions to conflicts.

545. MASS COMMUNICATION IN DEVELOPING NATIONS.
(3-0) Cr. 3. W.
Prerequisite: 440 or equivalent.
Evaluation and comparison of traditional and transitional systems of communication; study of the role of communications in societal growth; development, structure, and functions of systems in Africa, Asia, and Latin America.

590. SPECIAL PROBLEMS.
Cr. arr.
Prerequisite: Permission of instructor.
A. Broadcasting.
B. Visual/Pictorial.
C. Advertising/Public Relations.
D. Media Management.
E. Law.
F. History.
G. International.
H. Audiences and Effects.
I. Technology.

COURSES FOR GRADUATE STUDENTS, major or minor

650. SEMINARS IN JOURNALISM COMMUNICATION.
Cr. 3 each. Offered as demand warrants from following topic list:
A. Visual/Pictorial Communication.
B. Communication History.
C. Society and Mass Communication.
D. International Communication.
E. Communication Law.
F. Audiences and Effects.

699. RESEARCH.

LANDSCAPE ARCHITECTURE

Thomas A. Barton, M.L.A., Head of Department

Professor: Robert W. Dyas, M.L.A.

Associate Professor: Kenneth F. Lane, M.L.A.


Instructor: Gary Highshoe, M.L.A.

Undergraduate Study

For undergraduate curriculum in landscape architecture leading to the degree Bachelor of Science, see College of Agriculture, Curricula.

Landscape architecture is the profession concerned with the layout of land for economic use, with a definite regard for the natural and man-made beauty of the resulting landscape. It includes the study of factors affecting the characteristic of sites and the design, construction, and maintenance of sites. Among the types of land development normally included in professional practice are park and recreation areas, school grounds, institutional grounds, industrial sites, commercial sites, land subdivisions, and residential properties. The scale or scope of such projects varies from broad regional landscape analysis and planning to detailed design.

The curriculum, accredited by the American Society of Landscape Architects, provides the student with an education which, combined with experience, is necessary for professional registration in several states.

Graduate Study

The department offers work for the degree Master of Landscape Architecture with major in landscape architecture. Minor work is offered to students taking major work in other departments.

The degree Master of Landscape Architecture is granted upon the completion of two years of graduate study with a minimum of 60 credits in residence at Iowa State University.

Satisfactory completion of L.A. 500, 514, 515, 516, or their equivalents, and the accep-
tance of a thesis or a terminal project are required for the M.L.A. degree.

Students desiring to major in landscape architecture should present credits substantially equivalent to those secured by undergraduate students in the curriculum in landscape architecture at this institution.

There is no uniform foreign language requirement for the degree Master of Landscape Architecture; however, a satisfactory reading knowledge of German, French, Russian, or Spanish equivalent to those secured by undergraduate students in the curriculum in landscape architecture at this institution.

Open to graduate students for minor credit only: 404, 411, 412, 413, 436, 445, 490.

COURSES PRIMARILY FOR UNDERGRADUATE STUDENTS

110. ORIENTATION IN LANDSCAPE ARCHITECTURE.
   (1-0) Cr. R: F.
   Survey of landscape architecture and allied fields.

112. GRAPHIC COMMUNICATION.
   (Ur.Pl. 112) (0-9) Cr. 3. F.W.
   Introduction to and experimentration with the graphic media used by the landscape architect and urban planner, including instrument drawing, lettering, dimensioning, and freehand sketching.

113. LANDSCAPE PERCEPTION.
   (1-9) Cr. 4. S.SSI.
   Understanding and appreciation of form, space, and other visual aspects of the landscape. Sketching and experimentation with land and plant forms; fundamental spatial organization.

201. HISTORY OF LANDSCAPE ARCHITECTURE I.
   (3-0) Cr. 3. W.
   The development of landscape architecture from antiquity to modern times, with its relation to and influences of allied arts and professions. Lectures, readings, abstracts, and reports.

210. SURVEY OF LANDSCAPE ARCHITECTURE.
   (3-0) Cr. 3. S.SSI.
   Survey of the profession of landscape architecture. Design process, history, ecology, planting design, and planning the site, the city, and the region, are areas explored through lectures, visiting lecturers, movies, and slides. 210 is not acceptable for credit toward graduation for students majoring in landscape architecture.

213. THEORY OF LANDSCAPE DESIGN.
   (1-8) Cr. 4. S.
   Theory and principles of design are explored in two- and three-dimensional forms. An introduction to functional diagramming relating human use to site considerations is included.

231. PLANT MATERIALS I.
   (1-9) Cr. 4. F.
   Introduction to study of plant materials as used in landscape design. Emphasis is on trees, shrubs, and woody vines native or introduced to Iowa. Field trips on campus and to nearby parks, woods, and fields; one or more field trips will be off campus.

232. FUNDAMENTALS OF PLANTING DESIGN.
   (1-9) Cr. 4. W.
   Prerequisite: 231 or Hort. 480.
   Creative problems in the design of outdoor spaces, with emphasis on the selection and arrangement of plant materials. Functional, cultural, and aesthetic aspects are considered; includes design analysis, drawing of planting plans, and construction of scale models.

233. PLANT MATERIALS II.
   (1-9) Cr. 4. S.
   Prerequisite: 231 or Hort. 480.

   Study of trees, shrubs, vines, and herbaceous materials as used in landscape design. Emphasis is on important form, color, and textural aspects of introduced exotic horticultural species and varieties. Field trips on campus and to nearby parks, gardens, and landscape nurseries.

251. MATERIALS AND FUNDAMENTALS OF CONSTRUCTION.
   (2-4) Cr. 4. W.
   Prerequisite: C.E. 211A.
   An introduction to the landscape architect's construction materials, methods of construction, grading and earth volume computations, and construction drawings.

311. MASTER LAND PLANNING.
   (1-12) Cr. 5. F.S.
   Prerequisite: 213.
   Physical design methodology of large scale projects involving mixed land uses. Functional relationships between uses, physiographic, social, economic, and political factors are considered.

334. SITE PLANNING AND PLANTING DESIGN.
   (1-12) Cr. 5. F.W.
   Prerequisite: 213, 232.
   Site planning projects involving the location and integration of buildings, roads, parking areas, walks, and plant materials. Development of site plans and detailed planting plans.

341. TRAVEL AND PRACTICE.
   Cr. R: F.
   Field trip.

352. SITE PLANNING AND CONSTRUCTION.
   (1-12) Cr. 5. F.W.
   Prerequisite: 213, 251.
   Site planning projects involving the location and integration of buildings, roads, parking areas, and walks. Development of site plans, including grading plans and construction details.

404. OUTDOOR RECREATION IN THE UNITED STATES.
   (3-0) Cr. 3. W.
   Survey of historical aspects, current problems, and future trends; influence of natural resources. Introduction to planning and selection of sites for recreation use.

411. LAND ANALYSIS.
   (2-9) Cr. 5. F.S.
   Prerequisite: Junior classification.
   Analysis of the physical and biological processes of land. Investigations are made of limiting factors and opportunities as these are employed in planning and design for human use. Instruction includes visiting professors from allied fields.

412. LANDSCAPE EVALUATION.
   (1-12) Cr. 5. B.
   Prerequisite: 411.
   Interpretation and communication of landscape qualities; sketching, photography; graphic and oral presentations; field trips.
413. **ADVANCED LANDSCAPE DESIGN.**  
(1-12) Cr. 5. S.  
Prerequisite: 334, 352.  
Depth study of a comprehensive landscape architectural problem situated within an existing environment. Research, preliminary studies, conferences, and presentation of recommendations.

413. **ADVANCED LANDSCAPE DESIGN.**  
(1-12) Cr. 5. S.  
Prerequisite: 334, 352.  
Depth study of a comprehensive landscape architectural problem situated within an existing environment. Research, preliminary studies, conferences, and presentation of recommendations.

422. **HISTORY OF LANDSCAPE ARCHITECTURE II.**  
(3-0) Cr. 3. W.  
Prerequisite: 201.  
Theories, concepts, and effects of man's design influence upon his physical environment. Lectures, readings, abstracts, and reports.

436. **ADVANCED PLANTING DESIGN.**  
(2-9) Cr. 6. S.  
Prerequisite: 334.  
Advanced study of planting design.

446. **PLANNING RECREATION SYSTEMS.**  
(3-0) Cr. 3. S.  
Prerequisite: 404.  
Survey of techniques for planning recreation systems at city, county, state, regional, and national levels; criteria for determining location of recreation sites and their distribution.

453. **ADVANCED CONSTRUCTION.**  
(1-12) Cr. 5. F.  
Prerequisite: 352.  
Advanced problems in landscape construction, estimating construction costs, preparation of construction documents.

490. **SPECIAL PROBLEMS.**  
Cr. 2 to 4.  
Prerequisite: Permission of Instructor.  
H. Honors Program.  
Investigation of an approved topic of special interest to the student. Election of course and topic must be approved in advance. Offered only on a satisfactory-fail basis.

**COURSES PRIMARILY FOR GRADUATE STUDENTS, major or minor, open to qualified undergraduates**

500. **SEMINAR.**  
(1-0) Cr. 1. F.W.S.

514, 515, 516. **LANDSCAPE ARCHITECTURE DESIGN.**  
(0-9) Cr. 3 each. F.W.S.  
Prerequisite: 411.  
Programming, analysis, synthesis, and presentation phases in urban design, regional design, and recreational design and planning. An exploratory study of innovations in policy and design methods preliminary to preparation of a thesis or a terminal project.

517. **TERMINAL PROJECT.**  
Cr. arr. F.W.S.

**COURSE FOR GRADUATE STUDENTS, major or minor**

690. **RESEARCH.**  

**LIBRARY**

Warren B. Kuhn, M.L.S., Head of Department

Professor: Robert W. Orr, M.S.

Associate Professors: Matyne H. Easton, B.A.; John E. Galejs, M.A.L.S.; John C. McNee, A.M.L.S.; Margaret H. Orr, B.L.S.; Elizabeth A. Windsor, M.S.


Undergraduate Study

The Library offers instruction to increase facility in the independent use of libraries and books.

Graduate Study

The Library offers a series of noncredit seminars to assist graduate students in the use of library resources. The seminars are geared to the five broad disciplines: biological sciences, engineering, humanities, physical sciences, and social sciences. Registration will be accepted at the Library Reference Desk prior to the first class meeting.

COURSES PRIMARILY FOR UNDERGRADUATE STUDENTS

102. LIBRARY INSTRUCTION. Cr. R; F.W.S.
   For students in Engineering.
   Use of libraries and books

160. LIBRARY INSTRUCTION. (1-0) Cr. I. F.W.S.
   Use of libraries and books, including a survey of literature of major curricula.

MATHEMATICS

Wilfred E. Barnes, Ph.D., Head of Department


Associate Professors: Barry C. Arnold, Ph.D.; Peter Calwell, Ph.D.; Spencer E. Dickson, Ph.D.; Arlington M. Fink, Ph.D.; Robert J. Gregorac, Ph.D.; Kenneth A. Helmes, Ph.D.; Roger H. Homer, Ph.D.; Roy F. Keller, Ph.D.; Robert K. Meany, Ph.D.; Richard H. Sprague, Ph.D.; Anne K. Steiner, Ph.D.; Eugene F. Steiner, Ph.D.


Undergraduate Study

For the undergraduate curriculum in sciences and humanities, major in mathematics, leading to the degree Bachelor of Science, see Sciences and Humanities, Curriculum.

The program in mathematics offers training suitable for students planning to enter secondary school teaching; to begin work in a computation, research, or engineering laboratory; or to continue their studies in graduate school. The requirements for an undergraduate major
In mathematics are designed so that the student may have the opportunity for appropriate specialization to meet one or more of the foregoing objectives and, at the same time, obtain a thorough introduction to the mathematics underlying all of them.

The requirements for an undergraduate major in mathematics include 30 credits in mathematics beyond the college group requirement, some of these credits to be specified by the department and the remainder to be elected by the student in a manner consistent with his interests and objectives.

Credits earned in the courses 104, 105, 109, 161, 162, 190, 191, 192, and 205 cannot be counted for credit toward graduation by mathematics majors.

Graduate Study

The department offers work for the degrees Master of Science and Doctor of Philosophy with majors in mathematics and in applied mathematics, and minor work to students taking major work in other departments.

Students desiring to do graduate work with a major in this department should present at least 18 quarter credits of work in mathematics beyond calculus. It is desirable that this should include advanced calculus and abstract algebra.

The M.S. degree in this department may be taken either with or without thesis. Candidates for the M.S. and Ph.D. degrees must pass a written comprehensive examination covering basic graduate work. There is no foreign language requirement for the M.S. degree; for the Ph.D. ability to use two foreign languages (normally chosen from French, German, and Russian) as effective research tools in the student's area of specialization is required.

Master of Science candidates must have one year and Doctor of Philosophy candidates must have two years of supervised teaching experience. These minima are subject to increase in individual cases upon recommendation of the student's committee and approval of the department head.


COURSES PRIMARILY FOR UNDERGRADUATE STUDENTS

35. **HIGH SCHOOL GEOMETRY.**
   Cr. O. SS.
   Students who do not have the one unit of geometry listed in the entrance requirements of several of the colleges may satisfy this requirement by completing this course. It may also be used to satisfy the geometry prerequisite for Math. 50 in the Technical Institutes. Elements of Euclidean geometry including congruence, parallel lines, circles, similar polygons, perimeters and areas, surface areas, and volumes.

36. **HIGH SCHOOL ALGEBRA.**
   Cr. O. SS.
   Students who do not have the third half-unit of algebra listed in the entrance requirements of some of the colleges may satisfy this requirement by completing this course. It may also be used to satisfy the algebra prerequisite for Math. 50 in the Technical Institutes. Fractions, graphs, laws of fundamental operations, important formulas from geometry, factors, linear equations, exponents and radicals, ratio-proportion-variation, logarithms, progressions, binomial theorem, and inequalities.

37. **ALGEBRA AND TRIGONOMETRY.**
   Cr. O. F.W.S.S.
   Prerequisite: One and one-half units of high school algebra.
   Sets, inequalities, polynomial equations and systems of equations, analytical trigonometry, complex number field.

104. **FINITE MATHEMATICS.**
   (5-0) Cr. 5. F.W.
   Prerequisite: One and one-half units of high school algebra.
   Logical statements, introduction to theory of sets, probability, systems of linear inequalities, applications in the social sciences.

105. **INTRODUCTION TO MATHEMATICAL IDEAS.**
   (4-0) Cr. 4. W.S.
   Topics in number theory, algebra, and geometry, with the emphasis placed on their nontechnical content.

109. **PRECALCULUS MATHEMATICS.**
   (5-0) Cr. 5. F.W.S.S.
   Prerequisite: Two units of high school algebra, one unit of geometry, and one-half unit of trigonometry. For students who intend to take calculus.
   Inequalities, functions and their graphs, including rational, circular, exponential, and logarithmic functions.

110, 111, 112. **ANALYTIC GEOMETRY AND CALCULUS I, II, III.**
   (5-0) Cr. 5 each. F.W.S.S.
Prerequisite: 109 or placement by examination.

110: Graphs and equations of loci, lines, conics, limits, elementary differentiation, and integration. 111: Integration, applications of the definite integral, transcendental functions. 112: Analytic geometry, vectors, multivariate calculus, infinite series.

161, 162. INTUITIVE CALCULUS. (3-0) Cr. 3 each. 161: W.S.S; 162: S.SS.
Prerequisite: 104 or 109.
Analytic geometry, differentiation and integration of elementary functions. Will not serve as prerequisite to 213.

190, 191, 192. MATHEMATICAL CONCEPTS. (3-0) Cr. 3 each. F.W.S.S.
Prerequisite: 191, 190.
190, 191: Structure of the number system. 192: Geometrical concepts.

201, 202. INTERMEDIATE MATHEMATICAL ANALYSIS. (3-0) Cr. 3 each. 201: F.W; 202: W.S.
Prerequisite: 111.
The real number system, functions, and important theorems from calculus. Emphasis placed on developing mathematical maturity. Primarily for mathematics majors. Offered on satisfactory-fail basis only.

204. DISCRETE PROBABILITY. (3-0) Cr. 3. F.W.
Prerequisite: Five credits in mathematics. Elementary discrete probability.

205. LINEAR ALGEBRA. (3-0) Cr. 3. W.S.
Prerequisite: Five credits in mathematics. Elementary linear algebra and matrices.

213. ELEMENTARY DIFFERENTIAL EQUATIONS. (3-0) Cr. 3. F.W.S.S.
Prerequisite: 112.
Elementary theory and applications of ordinary differential equations.

301, 302, 303. INTRODUCTION TO ABSTRACT ALGEBRA. (3-0) Cr. 3 each. 301: F.W.S.S; 302: W.S.S.S; 303: F.S.
Prerequisite: 202.
Certain algebraic structures and their transformations, including groups, rings, and vector spaces.

307. THEORY OF MATRICES. (3-0) Cr. 3. F.S.S.S.
Prerequisite: 112.
Matrices and quadratic forms in the real and complex number fields.

308. APPLICATIONS OF LINEAR ALGEBRA. (3-0) Cr. 3. S.
Prerequisite: 205 or 303 or 307.
Linear programming; applications of canonical matrices.

321, 322. INTRODUCTION TO APPLIED MATHEMATICS I, II. (3-0) Cr. 3 each. F.W.S.S.S.
Prerequisite: 213.

330. TOPICS IN EUCLIDEAN GEOMETRY. (3-0) Cr. 3. S.S.S.
Prerequisite: 202.
Concepts and properties of Euclidean geometric systems.

331, 332, 333. TOPOLOGY. (3-0) Cr. 3 each. Yr.
Prerequisite: 202.
Topological properties of finite dimensional Euclidean space. Metric spaces and continuous transformations. Abstract spaces, continua, convergence, and fixed point theory.

406. INTRODUCTION TO NUMERICAL TECHNIQUES FOR COMPUTERS. (Com.S. 406) (3-2) Cr. 3. F.W.S.
Prerequisite: 112, Com.S. 201.
Finding roots of equations and solving systems of linear equations. Iterative methods; programming these methods for computer solution.

407, 408. NUMERICAL ANALYSIS I, II. (Com.S. 407, 408) (3-0) Cr. 3 each. 407: W; 408: S.
Prerequisite: 213, Com.S. 201.

409, 410, 411. MULTIVARIABLE CALCULUS AND COMPLEX VARIABLES. (3-0) Cr. 3 each. 409: F.W.S.S; 410: W.S.S.S; 411: F.S.
Prerequisite: 409: 213; 410: 409; 411: 410 or 415.
Certain frequently applied mathematical concepts presented with enough theory to promote understanding of applications. 410: Calculus of functions of several variables, including vector calculus, line, surface and multiple integrals. 411: Functions of a complex variable, including differentiation, integration and series expansions, residues and applications to evaluation of integrals, conformal mapping.

414, 415, 416. ADVANCED CALCULUS. (3-0) Cr. 3 each. Yr.
Prerequisite: 202.
414: Normed linear spaces, completeness, limits, iteration of limits, differentiation of vector functions. 415: Integration on the line, multiple integrals, Green's theorem. 416: Topics include manifolds, summability theory, integration theory, approximation theory, function algebras, Fourier analysis, fixed-point theorem.

421. MATHEMATICAL LOGIC. (3-0) Cr. 3. F.S.
Prerequisite: 301 or Phil. 370.
Validity, provability, consistency, completeness, definability, and decision problems for propositional calculus, predicate calculus, and generalized mathematical theories.

436, 437. PROJECTIVE GEOMETRY. (3-0) Cr. 3 each. 436: W; 437: S.
Prerequisite: 202.
Projective properties studied by synthetic and analytic methods.

450. NUMBER THEORY. (3-0) Cr. 3. S.
Prerequisite: 301.
Properties of the integers. Diophantine equations, prime number distribution and representation problems.

489. HISTORY OF MATHEMATICS. (3-0) Cr. 3. F.
Prerequisite: 112, junior classification.
Sources and growth of mathematical knowledge, contributions of outstanding mathematicians. Offered on satisfactory-fail basis only.

490. SPECIAL PROBLEMS. Cr. 1 to 3 each time taken.
Prerequisite: 202.
H. Honors Program.

497. TEACHING OF SECONDARY SCHOOL MATHEMATICS. (3-0) Cr. 3. W.
Prerequisite: Twenty-two credits in college mathematics.
Organization of subject matter, methods of presenting particular topics, evaluation of results.
COURSES PRIMARILY FOR GRADUATE STUDENTS, major or minor, open to qualified undergraduates

504, 505, 506. ABSTRACT ALGEBRA. (3-0) Cr. 3 each. Yr. SS.
Prerequisite: 302.
Algebraic systems and their morphisms including groups, rings, fields, modules, and categories.

507, 508. NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS. (Com.S. 507, 508) (3-0) Cr. 3 each. 507: F; 508: W.
Prerequisite: 408 or 410 or 415.

509. COMPUTATIONAL METHODS OF LINEAR ALGEBRA. (Com.S. 509) Cr. 3. S.
Prerequisite: 303 or 307.
Numerical methods involved in the solution of linear systems, matrix inversion, eigen-value problems (symmetric and non-symmetric); completion method, ill-conditioned matrices; linear inequalities. Examples using University computers.

511, 512, 513. FUNCTIONS OF A SINGLE COMPLEX VARIABLE. (3-0) Cr. 3 each. Yr. SS.
Prerequisite: 410 or 415.

514, 515, 516. REAL ANALYSIS. (3-0) Cr. 3 each. Yr. SS.
Prerequisite: 415.
Basic concepts of topological spaces, function spaces, measure and integration.

521, 522, 523. APPLIED MATHEMATICS. (3-0) Cr. 3 each. Yr. SS.
Prerequisite: 322, 411.

524, 525. THEORY OF AUTOMATA. (Com.S. 524, 525) (3-0) Cr. 3 each. 524: W; 525: S.
Prerequisite: 421.
Various notions and formalizations of computability and their comparison. Turing machines, Markov algorithms, recursive functions, unsolvability results, finite automata, sequential machines, synthesis and decomposition of abstract machines.

526, 527, 530. SPECIAL FUNCTIONS. (3-0) Cr. 3 each. 526: F; 527: W.
Prerequisite: 411.
Infinite products, asymptotic series, Gamma and Beta functions, hypergeometric functions, generalized and confluent hypergeometric functions, Bessel and Legendre functions, generating functions, orthogonal polynomials, elliptic functions.

531, 532, 533. INTRODUCTION TO FUNCTIONAL ANALYSIS. (3-0) Cr. 3 each. Yr.
Prerequisite: Permission of Instructor.
Fundamental theory of normed linear spaces and algebras emphasizing aspects which provide a framework for study of boundary-value problems, eigen-value problems, harmonic analysis and analytic function theory. Hahn-Banach theorem, Banach-StechBrowse theorem, Gelfand representation, elementary spectral theory for operators in Hilbert space.

534, 535, 536. TOPOLOGY. (3-0) Cr. 3 each. Yr.
Prerequisite: 333.
Introduction to general topology and homotopy theory.

537, 538, 539. ALGEBRAIC TOPOLOGY. (3-0) Cr. 3 each. Yr.
Prerequisite: 302, 333.
Foundations of algebraic topology. Homotopy and homology groups, fibrations, applications to manifolds.

544, 555. PROBABILITY AND HOMOLOGY. (Stat. 554, 555) (3-0) Cr. 3 each. 554: W; 555: S.
Prerequisite: Stat. 541.
Occupancy problems and combinations of events, generating functions, branching processes, recurrent events, Markov chains, queuing theory, Markov processes, general one-dimensional random walk.

557, 558, 559. ORDINARY DIFFERENTIAL EQUATIONS. (3-0) Cr. 3 each. Yr.
Prerequisite: 213; 303 or 307; 410 or 415.
The initial-value problem, existence and uniqueness theorems, linear systems, stability and asymptotic behavior of solutions, dynamical systems, two-point boundary-value problems.

562, 563. DIFFERENTIAL GEOMETRY. (3-0) Cr. 3 each. Alt. W. and S, offered 1972. Prerequisite: Permission of Instructor.
Differentiable manifolds, local and global properties of curves and surfaces in Euclidean spaces.

564, 565, 566. THEORY OF GROUPS. (3-0) Cr. 3 each. Alt. Yr. offered 1972-1973. Prerequisite: 505.
Commutators, transfer, p-groups, nilpotent groups, solvable groups, permutation groups, free groups, semidirect products, extension theory, introduction to representations and characters.

567. BOOLEAN RINGS. (3-0) Cr. 3. SS.
Prerequisite: Permission of Instructor.
Structure of semi-simple commutative rings and their representation. Atomicity and completeness. Stone space of Boolean rings. The field of Borel and Baire sets. Theorems on extension of homomorphisms. Applications to mathematical logic and measure theory.

571, 572, 573. MATHEMATICAL LOGIC. (3-0) Cr. 3 each. Yr.
Prerequisite: 421.
Algebraic structures in logical systems, recursive functions, consistency, undecidability and incompleteness of axiomatic theories, results of Gentzen and Gödel, theory of models, ultraproducts and nonstandard analysis.

581, 582, 583. AXIOMATIC SET THEORY. (3-0) Cr. 3 each. Yr.
Prerequisite: Permission of Instructor.
Axiomatic considerations, model and proof theory, Zermelo-Fraenkel axioms, classical theorems, transfinite methods, ordinal and cardinal numbers and their arithmetic. Von Neumann-Bernays-Gödel axioms, inaccessible cardinals, consistency and independence results of Gödel, Cohen and others.

584, 585, 586. HOMOLOGICAL ALGEBRA. (3-0) Cr. 3 each. Alt. Yr. offered 1971-1972. Prerequisite: 506.
Exact sequences, homology, functors Hom, Tor, Ext, K"{u}nneth formula, relative homological algebra, cohomology of algebraic systems.

587, 588, 589. INTRODUCTION TO INTEGRATION THEORY AND APPLICATIONS.
(3-0) Cr. 3 each. Yr.
Prerequisite: Permission of instructor.
INTRODUCTION TO INTEGRATION THEORY AND APPLICATIONS.
(3-0) Cr. 3 each. Yr.
Prerequisite: Permission of instructor.

587, 588, 589. INTRODUCTION TO INTEGRATION THEORY AND
APPLICATIONS.
(3-0) Cr. 3 each. Yr.
Prerequisite: Permission of instructor.

COURSES FOR GRADUATE STUDENTS,
major or minor

604. ADVANCED TOPICS IN ABSTRACT ALGEBRA.
(3-0) Cr. 3 each time taken. W.S.
Prerequisite: 506.
Associative or nonassociative algebras, groups, rings, fields, local algebras, categorical algebras.

607. ADVANCED TOPICS IN NUMERICAL ANALYSIS.
(Com.S. 607) (3-0) Cr. 3. S.
Prerequisite: 523; 508 and 509, or 408.
Stability and error analysis, numerical solution of partial differential equations, successive over-relaxation methods, research work using University computers.

610. SEMINAR.

611. ADVANCED TOPICS IN THE THEORY OF FUNCTIONS OF A SINGLE COMPLEX VARIABLE.
(3-0) Cr. 3 each time taken. F.W.S.
Prerequisite: 512, 536.
The Riemann sphere, conformal mappings, topological indices, Cauchy integral formulas, power series, Laurent series, local mapping theorems, harmonic functions, the Poisson integral formula, the Dirichlet problem, the Mittag-Leffler theorem, special functions.

615. ADVANCED TOPICS IN FOUNDATIONS OF MATHEMATICS.
(3-0) Cr. 3 each time taken. F.W.S.
Prerequisite: Permission of Instructor.

Topics in modern integration theory including integration of vector functions, integration with respect to finitely additive measures, theory of vector measures. Applications to problems in functional analysis.

590. SPECIAL TOPICS.
Cr. var.

MECHANICAL ENGINEERING

Henry M. Black, S.M., Head of Department

Professors: Robert C. Fellinger, M.S.; Jordan L. Larson, Jr., M.S.; Charles R. Mischke, Ph.D.; George K. Serovy, Ph.D.


Instructor: Vernon Mayer, M.S.

Undergraduate Study

For undergraduate curriculum in mechanical engineering leading to the degree Bachelor of Science, see College of Engineering, Curricula.

About one-fourth of all engineers today have been educated as mechanical engineers; they
work in every major industry. Their activities range from research and development through design, production, construction, and operation to sales and management. Their services are generally involved with the production, processing, and control of energy in its many applications in fields of manufacturing, transportation, power, agriculture, defense, and numerous others.

The curriculum is built upon a strong base of courses in the fundamental sciences of mathematics, physics, chemistry, and metallurgy. The engineering sciences included are mechanics of solids, materials, fluid mechanics, thermodynamics, heat transfer, and electrical theory. Applied courses in analysis, design, and experimental engineering provide background for real problem solutions, and a sequence of electives provides social-science and humanistic background.

Opportunity is offered senior students to specialize through technical electives in one of the many applied fields in mechanical engineering such as design, automatic control, power generation, automotive, air conditioning, and production engineering. Students who plan to continue in graduate study use these electives in preparation for advanced study.

A five-year cooperative work-study program is available in the Mechanical Engineering Department.

Graduate Study

The department offers work for the degrees Master of Science and Master of Engineering with major in mechanical engineering, and minor work to students taking major work in other departments. Work may be taken for the degree Doctor of Philosophy as a joint major with departments offering work in related fields.

Students desiring to major in this department should have completed an undergraduate curriculum equivalent to that required of undergraduate students in mechanical engineering at this institution.

The requirements for advanced degrees, including foreign languages, are controlled by the student's graduate committee. There is no foreign language requirement for the degree Master of Engineering. For the degree Master of Science, the foreign language requirement is at the discretion of the student's graduate committee. Candidates who expect to pursue doctoral work can anticipate a single language proficiency equivalent to one year of classroom preparation. The language requirement for the degree Doctor of Philosophy is also at the discretion of the student's graduate committee. Candidates can expect to demonstrate a high degree of competence in one language or a satisfactory reading competence in two languages. Approved languages are German, French, or Russian. English may be approved in the case of a student whose native tongue is not English.


COURSES PRIMARILY FOR UNDERGRADUATE STUDENTS

100. TECHNICAL LECTURE.
   (1-0) Cr. R; S.
   Field of mechanical engineering, its opportunities and requirements.

235. MECHANICAL BEHAVIOR OF METALS.
   (3-0) Cr. 3. W.
   Prerequisite: Met. 230; E.M. 324 or 325.
   Plastic deformation, fracture, fatigue, creep, and wear of metals. Mechanical and metallurgical aspects.

251. INTRODUCTION TO MECHANICAL ENGINEERING I, II.
   251: (4-0) Cr. 4. F; 252: (3-2) Cr. 4. W.
   Prerequisite: Math. 111, Phys. 222, E.Gr. 161.
   Nature of the design function in mechanical engineering, mathematical model building, formulation, inference, accuracy. Fortran, manipulation of mathematical models by digital and analog computers. Empiricism, complete sets of parameters, problems of measurement, error and its propagation, confidence in conclusion drawn from experiment.

300. INSPECTION TRIP.
   Cr. R; S.
   Prerequisite: Junior mechanical engineering classification.
   Inspection trip to industrial centers.

321. THERMODYNAMICS I.
   (4-0) Cr. 4. F.W.
   Prerequisite: Math. 213, Phys. 222, junior classification.
   Properties and fundamental equations for states and processes involving gases, vapors, and gas mixtures.

322. THERMODYNAMICS II.
   (3-0) Cr. 3. W.S.
   Prerequisite: 321.
   Air tables, compressible flow, compressors and turbines, air standard cycles for engines and turbines.
323. THERMODYNAMICS III.  
(3-0) Cr. 3. F.S.  
Prerequisite: 322.  
Vapor power cycles, refrigeration, property relations, and processes for real gases. Gas mixtures with constant and variable specific heats. Psychrometry and introduction to air conditioning processes.

324. THERMODYNAMICS IV.  
(3-0) Cr. 3. F.W.  
Prerequisite: 323.  

325. HEAT TRANSFER.  
(3-0) Cr. 3. S.  
Prerequisite: 344 or 321.  
Solution of practical engineering problems involving transfer of heat by conduction, radiation, and convection.

331. MECHANICAL METALLURGY.  
(Met. 331) (3-2) Cr. 4. F.W.SSI.  
Prerequisite: Met. 330, E.M. 325.  
Application of the basic principles of structure of solids to the study and control of mechanical properties of metals. Qualitative and quantitative relationships between the microstructure and mechanical properties. Ferrous and nonferrous systems.

332-333. MANUFACTURING PROCESSES I, II.  
(Met. 332, 333) (3-2) Cr. 3 each. 332: W.S. SSI; 333: F.S.  
Prerequisite: 332: 331; 333: 332.  
The relationship between material properties, manufacturing process, and product properties. The basic processes (casting, welding, forming, and machining) and the functional characteristics of equipment. Manufacturing considerations in design.

340. ENGINEERING MEASUREMENTS.  
(1-6) Cr. 3. W.  
Prerequisite: Junior classification, Math. 112, Phys. 223.  
Engineering measurements systems, basic measurement standards. Measurement accuracy. Types of errors and error propagation.

341. ENGINEERING INSTRUMENTATION AND MEASUREMENT.  
(2-3) Cr. 3. F.S.  
Prerequisite: Credit or classification in 420, E.E. 442.  

344. THERMODYNAMICS.  
(5-0) Cr. 5. F.W.SS.  
Prerequisite: Math. 112, Phys. 222.  

400. PROFESSIONAL CONDUCT.  
(1-0) Cr. R; F.  
Prerequisite: Senior classification.  
Engineering ethics, engineering registration. Professional organizations. Professional growth of the engineer.

406. HEATING, VENTILATION, AND AIR CONDITIONING.  
(4-0) Cr. 4. W.  
Prerequisite: Con.E. 372 or Arch. 343.  
Elements of heat transfer, thermodynamics, and fluid flow as applied to heating, ventilating, and air conditioning. Design of duct and piping systems.

407. MECHANICAL EQUIPMENT DESIGN.  
(2-6) Cr. 4. S.  
Prerequisite: 406.  
Heat loss and gain calculations. Analysis of system types. Design and layout of heating, air conditioning, and plumbing systems in buildings.

411. INDUSTRIAL AUTOMATIC CONTROLS.  
(2-2) Cr. 3. F.S.  
Prerequisite: 422.  
Methods and principles of automatic control. Pneumatic, hydraulic, and electrical systems. Representative applications of automatic control systems. Mathematical analysis of control systems.

416. ENGINEERING SYSTEMS ANALYSIS.  
(3-3) Cr. 4. S.  
Prerequisite: 422, 425, E.E. 442.  
The application of fundamental concepts from several areas to the solution of engineering problems. Mathematical statement of the problem. Introduction to analogies and dimensional analysis in problem solution. Analog and digital computing methods.

420. 421, 422. MACHINE DESIGN I, II, III.  
420: (4-0) Cr. 4. F.S.SSI; 421: (3-0) Cr. 3. F.W.SSI; 422: (3-0) Cr. 3. W.S.SSI.  
Prerequisite: 420: 235 or 332; Math. 321, E.M. 325, 345; 421: 422: 421.  
Theory of machines. Kinematics and dynamics of mechanisms, design and selection of machine elements, vibratory phenomena, introduction to automatic control theory.

423. MECHANICAL SYSTEMS DESIGN.  
(1-9) Cr. 4. F.S.SSI.  
Prerequisite: 422.  
Solution of total design problems involving the use of basic engineering concepts and industrial practices.

424. 425. FLUID FLOW AND HEAT TRANSFER.  
424: (3-2) Cr. 4. W.S.SSI; 425: (4-0) Cr. 4. F.W.SSI.  
Prerequisite: E.M. 345, Math. 321, credit or classification in M.E. 322.  

426. REFRIGERATION AND AIR CONDITIONING.  
(3-0) Cr. 3. F.W.  
Prerequisite: 325 or 425.  
Principles of refrigeration; analysis of refrigeration cycles. Principles of air conditioning with emphasis on thermodynamic processes involving air-water vapor mixtures.

427. HEATING AND AIR CONDITIONING DESIGN.  
(2-6) Cr. 4. S.  
Prerequisite: 426.  
Design and layout of heating, ventilation, and air conditioning systems.

428. REFRIGERATION.  
(3-0) Cr. 3. S.  
Prerequisite: 426.  
429. INTERNAL COMBUSTION ENGINE DESIGN. (2-6) Cr. 4. S.
Prerequisite: 445, credit or classification in 423. Design and layout of a high-speed internal combustion engine of carburation or diesel type.

444. STEAM POWER PLANTS. (3-0) Cr. 3. W.S.
Prerequisite: 425, 324.
Thermodynamics and performance of boilers, turbines, pumps, heat exchangers, and other power plant equipment. Efficiency and economy of modern stations and their cycles.

445. INTERNAL COMBUSTION ENGINES. (3-0) Cr. 3. W.S.SSI.
Prerequisite: 324, credit or classification in 425. General principles, thermodynamics, and performance of carburation and fuel-injection engines. Characteristics of fuels.

446. 447. ARCHITECTURAL TECHNOLOGIES II. (Arch. 446, 447) See Architecture.

448. STEAM POWER PLANT DESIGN. (2-6) Cr. 4. S.
Prerequisite: 444.
Principal and auxiliary equipment for power, heating, and pumping plants. Cooling towers, boiler water treatment, principles of plant design.

461. ENGINEERING MEASUREMENTS I. (2-3) Cr. 3. F.W.
Prerequisite: 420, E.E. 442.
Fundamentals of design, selection and operation of instrumentation components of measuring systems.

462. ENGINEERING MEASUREMENTS II. (1-6) Cr. 3. W.S.
Prerequisite: 252, 461.
ASME Power Test Codes and ASTM Standard Test Procedures applied to selected areas of measurement; use of analogies and similarity in engineering experimentation, advanced engineering measurements, presentation of formal reports.

470. COMPUTER-AIDED DESIGN. (3-0) Cr. 3. S.
Prerequisite: Senior classification in engineering and an elementary knowledge of FORTRAN. An examination of the morphology of design processes, the structure of the FORTRAN language, figures of merit, searching and optimization techniques leading to an algorithmic approach to design.

490. SPECIAL PROBLEMS. Cr. 3 to 5.
Prerequisite: Senior classification. Investigation of topic holding special interest of student. Comprehensive report required. Election of course and topic must be approved by department head.
H. Honors Program.

COURSES PRIMARILY FOR GRADUATE STUDENTS, major or minor, open to qualified undergraduates

501. DESIGN OF ENGINEERING EXPERIMENTS I. (2-3) Cr. 3. F.
Prerequisite: 252 or Stat. 401.

502. DESIGN OF ENGINEERING EXPERIMENTS II. (3-0) Cr. 3. W.
Prerequisite: 501.
Planning of experimental programs and design of experiments to obtain data such that results are within prescribed limits of precision.

513. LUBRICATION AND FRICTION. (4-0) Cr. 4. W.
Prerequisite: 420, 424.
Theories of lubrication and friction and their application to design.

515. ADVANCED DESIGN. (4-0) Cr. 4. W.
Prerequisite: 511.
Experimental, empirical, and rational methods of analysis and synthesis in the solution of advanced design problems.

516. ADVANCED KINEMATICS OF MECHANICS. (3-0) Cr. 3. F.
Prerequisite: 421.
Analysis of simple and complex mechanisms. Goodman's and Carter's methods; auxiliary-point and normal acceleration methods. Advanced kinematics of plane motion; Euler-Savory equation, inflection circle, polede curvature, the cubic of stationary curvature.

517. KINEMATIC SYNTHESIS OF MECHANISMS. (2-0) Cr. 2. W.
Prerequisite: 516.
Synthesis of mechanisms; graphical, analytical, and graphical-analytical methods.

521. INTERMEDIATE TOPICS IN THERMODYNAMICS. (3-0) Cr. 3. F.
Prerequisite: 322 or 344.
Students may not receive credit in both 521 and 621. General equations for properties of the pure substance. Third law and absolute entropy. Real gas equations of state. Processes involving real gas effects.

522. THERMODYNAMICS OF COMPRESSIBLE FLOW I. (4-0) Cr. 4. W.
Prerequisite: 321 or 344; 424 or E.M. 378.

523. THERMODYNAMICS OF COMPRESSIBLE FLOW II. (Aero.E. 524) (4-0) Cr. 4. S.
Prerequisite: 523.
Generalized one-dimensional steady internal flow. Theory and application of one-dimensional unsteady compressible flow.

525. HEAT TRANSFER. (4-0) Cr. 4. W.
Prerequisite: 425 or equivalent.
Intermediate-level treatment of heat transmission by conduction, convection, and radiation. Intended for those who require a general coverage of theory and methods but whose primary research interests are in other areas.

540. ADVANCED COMBUSTION. (3-0) Cr. 3. Alt. W. offered 1972.
Prerequisite: 324.

541, 542, 543. ADVANCED AERODYNAMICS. (Aero.E. 541, 542, 543) See Aerospace Engineering.

544. PRINCIPLES OF TURBOMACHINERY. (4-0) Cr. 4. F.
Prerequisite: 322, 424.
Application of the concepts and methods of fluid mechanics and thermodynamics to the analysis of flow in turbomachinery components.

545. FLIGHT PROPULSION SYSTEMS. (Aero.E. 545) (3-0) Cr. 3. S.
Prerequisite: 523, and 544 or Aero.E. 413.
Analysis and selection of propulsion systems for flight vehicles. Optimization of components and design parameters for atmospheric flight and for power and thrust generation in space.

549. EXPERIMENTAL GAS DYNAMICS AND SHOCK TUBE THEORY. (Aero.E. 549) (2-3) Cr. 3. S.
Prerequisite: 523.
Theory of shock tube operation for the production of shock waves with the corresponding high-temperature, high-velocity gas flows. Instrumentation for the measurement of thermodynamic properties, heat transfer, shock-wave velocity, and boundary-layer phenomena in shock tubes.


590. SPECIAL TOPICS. Cr. 2 to 8.
Investigation of problems of special interest to graduate students in mechanical engineering. Election of course and problem must be approved in advance.
A. Special course study.
B. Independent literature investigation. Comprehensive report required.

COURSES FOR GRADUATE STUDENTS, major or minor

600. ADVANCED MACHINE DESIGN. (3-0) Cr. 3. S.
Prerequisite: Permission of instructor.
Mathematical and experimental analysis of problems in field of dynamics of machinery, stress analysis, and vibration. Choice of work any quarter determined by aptitudes and interests of class.

610. DYNAMICS OF FLUID CONTROL SYSTEMS. (3-0) Cr. 3. W.
Prerequisite: 411, 424.
Dynamical characteristics of fluid control systems and elements

620. SEMINAR. (1-0) Cr. 1. F.

621, 622. ADVANCED ENGINEERING THERMODYNAMICS. (4-0) Cr. 4 each. Alt. S; 621: Offered 1972; 622: Offered 1973.
Prerequisite: Permission of instructor.
Fundamental concepts of thermodynamics, thermodynamic laws, temperature, entropy, general thermodynamic equations, properties of steam, availability, equilibrium. Thermodynamics of thermoelectricity. Special topics.


Prerequisite: 425 or equivalent.
Techniques for the analysis of problems involving steady-state and transient heat conduction in solids.

626. ADVANCED HEAT TRANSFER II. (3-0) Cr. 3. Alt. W, offered 1973.
Prerequisite: 425 or equivalent.
The boundary layer concept and its relation to convective heat transfer. Methods for analysis of the convection process in internal and external flow.

627. ADVANCED HEAT TRANSFER III. (3-0) Cr. 3. Alt. S, offered 1973.
Prerequisite: 425 or equivalent.
Transfer of energy by thermal radiation.

Prerequisite: 544.


699. RESEARCH.

METALLURGY
Monroe S. Wechsler, Ph.D., Chairman of Department


Associate Professors: Chih W. Chen, Ph.D.; Alexander Henkin, Ph.D.; William L. Larsen, Ph.D.; Tom E. Scott, Ph.D.; Rohit K. Trivedi, Ph.D.

Assistant Professors: Donald M. Bailey, M.S.; Francis X. Kayser, Sc.D.; John W. Patterson, Ph.D.
Undergraduate Study

A student interested in the area of metallurgy can pursue studies leading to the degree Bachelor of Science in either the College of Engineering or the College of Sciences and Humanities. For an undergraduate curriculum in metallurgy, see College of Engineering, Curricula.

To best prepare the student to meet the challenges of this broad field, the engineering curriculum in metallurgy is based on a core of courses in chemistry, physics, mathematics, and metallurgical engineering principles. A wide choice of electives makes it possible for the student, in consultation with his adviser, to develop a program which best fits his particular interests and aptitudes. The curriculum is designed to permit specialization in mechanical, chemical, or physical metallurgy through the choice of electives in the third and fourth years. Elective programs should complement the core curriculum, avoiding undue specialization or aimless diversification.

For an undergraduate curriculum in sciences and humanities, with a major in metallurgy, see Sciences and Humanities, Curriculum. Students in this curriculum usually will select the following basic courses: 201, 203, 205, 230, 300, 301, 302, 303, 305, 306, 307, 360, 361, 401, 402, and six additional credits in courses numbered 400 or above. As supporting work, undergraduate majors find the following courses desirable: Math. 109, 110, 111, 112, 213 plus one additional course in mathematics, statistics, or computer science; Phys. 221, 222, 223, 301, 302, 303; Chem. 141, 141L, 142, 142L, 321; or 147, 147L, 148, 148L, 321. These lists of courses are not regarded as fixed requirements or as complete outlines of work necessary for the major. Students will plan their complete programs with the help of their advisers.

The metallurgist finds opportunities in many industries such as the metal-producing, refining, and processing industries or those which utilize metals such as the automotive, aircraft, utilities, electronic, oil refining and farm implement industries. He may choose to work in the areas of production, sales, or research. The demand is particularly high for metallurgists with training beyond the bachelor's degree. Students interested in teaching or research in metallurgy should seriously consider graduate study.

Graduate Study

The department offers work for the degrees Master of Science and Doctor of Philosophy with major in metallurgy. Minor work is available to students taking major work in other departments.

Prerequisite to graduate study in metallurgy is completion of an undergraduate curriculum in metallurgy or metallurgical engineering or in a closely allied field such as materials engineering or science, physics, chemistry, ceramic engineering, chemical engineering, or mechanical engineering. Students majoring in metallurgy will usually choose supporting course work in these or similar allied fields.

No foreign language is required for the degree Master of Science. Before admission to candidacy for the degree Doctor of Philosophy, the student is required to demonstrate his proficiency in either French, German, or Russian by attaining a score of 600 for French or 525 for German or Russian in the Educational Testing Service examination. After satisfying the requirement, the student must translate one journal article per quarter for three consecutive quarters; the articles will be chosen and the translation approved by the major professor.

Excellent facilities are provided by the Department of Metallurgy and the Institute for Atomic Research for investigations in theoretical and applied fields of metallurgy.

Courses open to graduate students for minor credit only: 301, 302, 303, 305, 306, 307, 360, 361, 401, 402, 410, 433.

COURSES PRIMARILY FOR UNDERGRADUATE STUDENTS

100. TECHNICAL LECTURE. (1-0) Cr. R. 8.
Introduction to the metallurgical profession. Career opportunities and requirements.

201. EXTRACTIVE METALLURGY. (3-0) Cr. 3. W.
Prerequisite: Chem. 142, 142L.
Occurrence and preparation of metals. Stoichiometry and material balances. Introduction to equilibria and thermodynamics.

203. METAL PROCESSING. (3-0) Cr. 3. S.
Prerequisite: 230 or 231, and Chem. 142, 142L.
Methods and principles of consolidation and primary working of metals, including melting, casting, joining, and powder metallurgy.
205. METALLURGY LABORATORY.
(1-6) Cr. 3. S.
Prerequisite: 201; 230 or 231; Phys. 223.
Introduction to experimental metallurgy. Principles and use of laboratory instruments, taking and analysis of data. Laboratory safety, report writing.

230. PRINCIPLES OF MATERIALS SCIENCE.
(4-0) Cr. 4. F.S.
Prerequisite: Chem. 142 and 142L.
Crystal structure, imperfections, and bonding in solids. The relation of structure to properties.

231. METALLURGY FOR ENGINEERS.
(3-0) Cr. 3. F.W.
Prerequisite: Chem. 141, Math. 111.
Introduction to atomic bonding, structure of crystals and polycrystalline aggregates, deformation of solids, phase equilibria, and transformations. Applications to the engineering properties of metals. For students not majoring in metallurgy.

300. METALLURGY SEMINAR.
(1-0) Cr. 1. F.W.S.
Topics of current interest in metallurgy.

301, 302, 303. PHYSICAL METALLURGY.
(4-0) Cr. 4 each. Yr.
Prerequisite: 230 or 231.
301: Stereography, X-ray diffraction, basic dislocation theory, deformation of metals. 302: Grain boundaries, grain growth, vacancies, diffusion, nucleation, solidification, recovery, and recrystallization. 303: Solid solutions, precipitation hardening, twinning and martensite reactions, transformation kinetics, strengthening processes.

(0-2) Cr. 2 each. Yr.
To be taken concurrently with sequence 301, 302, 303. Experiments in X-ray diffraction, measurement of physical properties, pyrometry, heat treatment, metallography, mechanical testing.

331. MECHANICAL METALLURGY.
(M.E. 331) See Mechanical Engineering.

332, 333. MANUFACTURING PROCESSES I, II.
(M.E. 332, 333) See Mechanical Engineering.

360. METALLURGICAL THERMOCHEMISTRY.
(3-0) Cr. 3. W.
Prerequisite: Chem. 321.
Concepts of fugacity, activity, activity coefficient, and the equilibrium constant. Thermodynamic description of solutions and unary and binary phase boundaries. Reaction kinetics, the electrochemistry of solid and liquid electrolytes and an introduction to corrosion theory.

361. CHEMICAL METALLURGY.
(3-0) Cr. 3. S.
Prerequisite: Math. 213, Phys. 222, Chem. 142, 142L.
Principles of fluid flow, heat and mass transfer. Applications to solidification, furnace design, pyrometry, reactions at metal surfaces and kinetics of metallurgical processes.

401, 402. MECHANICAL BEHAVIOR OF METALS.
(3-0) Cr. 3 each. 401: F; 402: W.
Prerequisite: 303.
Elasticity and plasticity, applications to metallurgical problems and materials testing. Fracture, fatigue, and residual stresses. Advanced metal-processing technology.

410. PHYSICAL METALLURGY.
(4-0) Cr. 4. F.
Prerequisite: Permission of Instructor.
An introduction to physical metallurgy for advanced students in science or engineering who have little or no prior preparation in metallurgy. Not open for credit to students majoring in metallurgy.

433. METALLURGICAL ENGINEERING DESIGN.
(3-0) Cr. 3. S.
Prerequisite: 402.
The application of physical, chemical, and mechanical metallurgical principles to the design of metal parts and processes.

490. SPECIAL PROBLEMS.
Cr. arr.
Prerequisite: Junior classification, permission of Instructor.
Investigation of individual research problems or special topics.
H. Honors.

COURSES PRIMARILY FOR GRADUATE STUDENTS, major or minor, open to qualified undergraduates

501, 502, 503. ADVANCED PHYSICAL METALLURGY.
(3-0) Cr. 3 each. Yr.
Prerequisite: 303 or 410.

512. INTRODUCTORY METAL THEORY.
(3-0) Cr. 3. F.
Prerequisite: Credit or classification in Math. 409.

532. STRUCTURE AND PROPERTIES OF STEEL.
(3-0) Cr. 3. S.
Prerequisite: 303, and 331 or 410.
Application of fundamental concepts of phase transformations, mechanical behavior, and heat flow to the problems of heat treatment and selection of steels.

540. THEORY OF DISLOCATIONS.
(3-0) Cr. 3. F.
Prerequisite: Credit or classification in Math. 409.
Theory of dislocations based on linear elasticity. Self and interaction energies of dislocations. The concept of forces on dislocations and their calculations; line tension, image, chemical and Peierls forces.
541. APPLICATIONS OF DISLOCATION THEORY.  
(3-0) Cr. 3. W.  
Prerequisite: 540.  
Dislocations treated from the geometric viewpoint. Partial dislocations, stacking faults, and pile-ups; dislocation generation, multiplication, point-defect production, dislocation networks and boundaries. Concepts applied to strengthening mechanisms and deformation.

545. X-RAY DIFFRACTION.  
(3-0) Cr. 3. W.  
Prerequisite: 301 or 410.  
Kinematical diffraction theory, dispersion-corrected scattering factors, the Debye-Waller factor, refraction and extinction. Applications of Debye-Scherrer and diffractometer methods, and neutron and electron diffraction.

557. X-RAY DIFFRACTION LABORATORY.  
(0-6) Cr. 2. S.  
Prerequisite: 555.  
Determination of the orientation of single crystals, crystal structure, lattice parameters, particle sizes, long-range order parameters, residual stresses, phase boundaries in alloys and retained austenite. Statistical methods of error analysis and computer programmed solutions.

561. PRINCIPLES OF CHEMICAL METALLURGY.  
(3-0) Cr. 3. F.  
Prerequisite: Chem. 321.  
Occurrence and production of metals, including the less common metals. Analysis of the economic, stoichiometric, and thermodynamic principles in chemical metallurgy.

562. PRINCIPLES OF METALLURGICAL THERMODYNAMICS.  
(3-0) Cr. 3. F.  
Prerequisite: Chem. 321, Math. 213.  
Classical thermodynamics, consequences of the three laws, application and the mathematical basis for the description of homogeneous and heterogeneous equilibria and phase relations in unary and multicomponent systems.

563. APPLICATIONS OF METALLURGICAL THERMODYNAMICS.  
(3-0) Cr. 3. W.  
Prerequisite: 562.  
Solubility of gases in metals, oxidation of metals and alloys, thermochemistry of steelmaking, atmosphere control with gas mixture, special applications of Clausius-Clapeyron equation, use of Richardson and Jeffes charts, thermodynamics of alloys and interaction coefficients.

565. OBSERVATIONS OF DEFECTS IN CRYSTALS.  
(2-0) Cr. 2 each time taken. Alt. F, offered 1971.  
Prerequisite: Math. 555 or permission of instructor.  
Selected topics including temperature diffuse scattering, the Debye-Waller factor, short- and long-range order, stacking faults in metals, extinction effects, dynamical theory of diffraction.

611. ALLOY THEORY.  
(3-0) Cr. 3 each. Alt. F; 610 offered 1972; 611 offered 1971.  
Prerequisite: 512.  
Cohesion and bonding in matter; their relationship to structure, thermodynamics, other physical properties, and the factors affecting alloying behavior of metals. 610: Emphasis on solid solutions and liquid alloys. 611: Emphasis on intermetallic phases.

640. OBSERVATIONS OF DEFFITS IN CRYSTALS.  
(3-0) Cr. 3. Alt. S. offered 1972.  
Prerequisite: 512.  
Transmission electron microscopy and its application to the study of dislocations, precipitates, clusters of point defects, stacking faults, and magnetic and antiphase domain boundaries. Electron diffraction and Moiré patterns. Fieldion microscopy.

655. X-RAY SCATTERING FROM CRYSTALS.  
(2-0) Cr. 2 each time taken. Alt. F, offered 1971.  
Prerequisite: Math. 555 or permission of instructor.  
Selected topics including temperature diffuse scattering, the Debye-Waller factor, short- and long-range order, stacking faults in metals, extinction effects, dynamical theory of diffraction.

691. METALLURGY SEMINAR.  
Cr. arr.

699. RESEARCH.

METEOROLOGY

For description of courses, see Earth Science.

MILITARY SCIENCE

Col. Robert B. Barnett, B.S., Head of Department

The Army military education program is designed to qualify undergraduate and graduate students for commissioning as second lieutenants and for a professional or reserve officer career. Freshmen and upperclassmen with four years of academic work remaining, two years of which must be undergraduate work, are encouraged to enroll in the four-year program. Continuation in the last two years of the four-year program is by application and is competitive. Men with sophomore or higher academic status and with two or more years of academic work remaining may apply for the two-year program during the winter prior to the academic year they wish to start the program. Successful applicants will attend a six-week summer session at a military installation which qualifies them to enter the third year of the four-year program. Upon completion of the third year of Military Science, all students attend an advanced six-week summer session at an active military installation. Students who complete the two- or four-year program and who have been awarded a baccalaureate or higher degree are commissioned as second lieutenants. Army scholarship students and students designated as Distinguished Military Graduates may apply for and, if selected, receive a Regular Army commission; all others receive commissions in the Army Reserve.

Army financial assistance grants (scholarships) for from one- to four-years duration are available as described in the "Officer Education Programs" portion of this catalog. Qualified students desiring to become Army aviators may enter the Flight Program during their fourth year of Military Science and earn the FAA private pilot's certificate. Third- and fourth-year students in the four-year program and all two-year program students receive a monthly subsistence allowance. All students are furnished uniforms and military science textbooks and all expenses involved for the six-week summer sessions at military installations.

Active duty obligations are as follows: four years for Army scholarship students, three years for Regular Army commissionees, three years for Flight Program students and from three months to two years for all others.

Undergraduate Study

Army officer education students may pursue any curriculum leading to a baccalaureate or higher degree. Four-year program cadets must complete 7 credits of 100- and 200-level Military Science courses during the first two years. All two- and four-year program cadets must complete 18 credits of 300- and 400-level Military Science courses plus one of the following courses prior to being commissioned:

Introduction to International Politics, Pol.S. 251, 3 cr.
International Law, Pol.S. 422, 3 cr.
United States Foreign Policy, Pol.S. 458, 3 cr. (preferred)

Four-year program students must also complete History 387A prior to their third year of officer education and 387B prior to being commissioned in lieu of enrolling in Military Science during the winter quarter of their second year. All students must take the leadership training course listed in conjunction with the Military Science Course they are taking (e.g., MS101A with MS101). Military Science courses are designed primarily for students seeking a commission in the United States Army; however, any student may enroll in a particular course, subject to the approval of the professor of military science and the availability of classroom space.

Also see Officer Education, this catalog.

COURSES PRIMARILY FOR UNDERGRADUATE STUDENTS

101. MILITARY SCIENCE I—PRINCIPLES OF MILITARY ORGANIZATION.
(1-0) Cr. 1. P. Military organizational structure from the smallest unit through the division level.

102. MILITARY SCIENCE I—EVOLUTION OF WEAPONS AND WARFARE.
(1-0) Cr. 1. W. Evolution of means to wage war as affected by technological developments and changing concepts, with emphasis on modern weapons systems, including use and maintenance of individual weapons.

103. MILITARY SCIENCE I—THE UNITED STATES DEFENSE ESTABLISHMENT.
(1-0) Cr. 1. S. Role and organization of the national defense establishment as an instrument of policy in providing for the national security. Interrelationships of the Department of Defense, State Department, Joint Chiefs of Staff, and the services under the Department of Defense.
101A, 102A, 103A. LEADERSHIP TRAINING I. (0-1) Cr. R; Yr.
Initial military training to provide experience in leadership and to teach the customs and courtesies of the service.

201. MILITARY SCIENCE II—LAND NAVIGATION. (2-0) Cr. 2. F.
Prerequisite: 103 or approval of professor of military science.
Characteristics and features of the earth's land mass and application of methods of conducting navigation on land by use of topographical maps and aerial photographs.

203. MILITARY SCIENCE II—MILITARY TACTICS. (2-0) Cr. 2. S.
Prerequisite: 201 or approval of professor of military science.
Actions and attitudes applied in both nuclear and nonnuclear warfare; consideration of the principles of organization, composition, and missions of operational elements in limited, conventional, and general war.

201A, 202A, 203A. LEADERSHIP TRAINING II. (0-1) Cr. R; Yr.
Prerequisite: 203A.
A continuation of skills learned in Leadership Training I. Emphasis placed on the exercise of command, instructing, correcting, and evaluating military leadership techniques.

301. MILITARY SCIENCE III—PRINCIPLES OF LEADERSHIP. (3-0) Cr. 3. F.
Prerequisite: 203 or completion of a six-week summer camp for two-year students; approval of the professor of military science.
Psychology of leadership, including the responsibilities and qualities of a leader, human behavior, objectives, functions, and techniques. Characteristics and requirements for effective and secure communication.

302. MILITARY SCIENCE III—MILITARY METHODS OF INSTRUCTION. (3-0) Cr. 3. W.
Prerequisite: 301.
Basic educational psychology, oral presentation techniques, use of training aids, lesson planning, presentation of subjects to incorporate all phases of effective instruction.

303. MILITARY SCIENCE III—FUNDAMENTALS AND DYNAMICS OF THE MILITARY TEAM. (3-0) Cr. 3. S.
Prerequisite: 302.
Roles and functions of the various branches of the Army. Offensive and defensive operations; internal defense development.

301A, 302A, 303A. LEADERSHIP TRAINING III. (0-1) Cr. R; Yr.
Prerequisite: 203A or Basic Summer Camp.
Advanced training pertaining to the duties and responsibilities of leaders; commanding and motivating groups of men; planning, organizing, supervising, inspecting, and conducting military activities.

310. ADVANCED ROTC SUMMER CAMP—FIELD. Cr. R; SS.
Prerequisite: 303, 303A.
Six-week summer session. Instructions in operations, weapons and fortifications.

401. MILITARY SCIENCE IV—ROLE OF THE UNITED STATES IN WORLD AFFAIRS. STAFF OPERATIONS. (3-0) Cr. 3. F.
Prerequisite: 401.
World alignment of nations; factors of national power and international conflict. Operation and functions of staff agencies assigned to major command elements.

402. MILITARY SCIENCE IV—ARMY ADMINISTRATION AND LOGISTICS. (3-0) Cr. 3. W.
Prerequisite: 401.
The role of the Army officer in unit administration; Department of the Army regulations; administrative policies; logistics; supply and evacuation; movement of troops; vehicle operation and movement.

403. MILITARY SCIENCE IV—MILITARY LAW AND CUSTOMS OF THE SERVICE. (3-0) Cr. 3. S.
Prerequisite: 402.
The uniform code of military justice; administrative and judicial techniques; history and traditions of the United States Army; instruction in the officers' code and customs of the service.

401A, 402A, 403A. LEADERSHIP TRAINING IV. (0-1) Cr. R; Yr.
Prerequisite: 303A.
Emphasis on leading and motivating large groups of men; staff procedures; planning, coordination, and execution of various training requirements; leadership techniques required of junior officers.

MUSIC

N. Laurence Burkhalter, Ph.D., Head of Department

Professor: Alvin R. Edgar, D.Music

Associate Professors: Carl O. Bleyle, Ph.D.; Max Exner, M.A.; Richard Koupal, M.M.; Ilza Niemack; Eugene Pridonoff, M.M.; W. Douglas Pritchard, D.M.A.; Frantisek Smetana; Arthur Swift, Ph.D.; Gary White, Ph.D.

Assistant Professors: Rolle Blondeau, M.M.; Joseph Messenger, M.M.; Acton Ostling, Jr., M.M.; Charles Stark, M.M.; Richard von Grabow, M.A.

Instructors: Bruce Eberle, M.M., M.M.A.; Martha Folts, M.M.; Laurie Kelling, M.M.; Bonnie Pridonoff, B.M.; Viletta Sue Ware, M.M.
Undergraduate Study

The Iowa State University Department of Music maintains a philosophy of education which draws its goals from the larger purposes of liberal arts education. As a humanistic discipline, music is an integral part of the college program which attempts to offer the student a broad background in all areas of human experience. The program of the music department is twofold:

1. To provide opportunities for any student to develop an understanding and appreciation of music as part of a liberal education. Courses in music literature, theory, and areas of performance are available to the general student.

2. To provide a four-year course of professional studies to students who wish to prepare for careers in teaching, performance, composition, and graduate studies in music or other related areas.

Bachelor of Arts—Music Major

For the undergraduate curriculum in sciences and humanities, major in music, leading to the degree Bachelor of Arts, see Sciences and Humanities, Curriculum.

Candidates for the degree Bachelor of Arts with a music major will normally complete the following courses: 104, 119, 201, 202, 203, 219, 304, 305, 306, 319, 355, 356, 357, 361, 419, and 4 to 6 credits from: 371, 373, 375, 376, 377, 380, 382, and 490D. All students are expected to participate in performing ensembles each quarter. The following may be taken on an elective basis: 362, 367, 368, 369, 490A, B, C, D, E, F, H.

Bachelor of Arts students whose chief professional interest lies in research are encouraged to minor in foreign languages, history, literature, or philosophy.

Bachelor of Music

For the undergraduate curriculum in music, leading to the degree Bachelor of Music, see Sciences and Humanities, Curriculum.

Candidates for the Bachelor of Music will complete the following requirements:

1. General Education
2. Library and Physical Education
3. Music Core
4. Music Major (Students must select one of the following areas of concentration: history and literature, music education—vocal, music education—instrumental, organ, piano, string instruments, theory-composition, voice, and wind or percussion instrument.)

General Requirements

Music majors are normally required to pass the department piano proficiency examination. In addition, candidates for the Bachelor of Music should pass a terminal piano proficiency examination for their major.

All music majors enrolled for applied music courses will attend a 1-hour seminar each week in their areas; applied grades will reflect attendance and participation in these seminars. All music majors will enroll in Music 490X (Recital Attendance) each quarter in which they are enrolled in 119, 219, 319, or 419.

Proficiency in music repertoire and technique will be determined by departmental examination as follows:

Acceptance Examination. To be accepted as a music major, the student must demonstrate an appropriate level of performance as well as potential in at least one performing medium. In addition, he must satisfactorily complete a standardized music achievement examination which will be administered to all applicants. The acceptance examination will be given by members of the departmental faculty during summer orientation, the week preceding the opening of classes for fall quarter, during the annual Talent Evaluation Day, or by appoint-
Students should request this examination in the Department of Music office before deciding on the music major.

Continuation Examination. To be approved for continuation as music majors on the junior level and beyond, students must pass a continuation examination in repertoire and technique (normally at the end of the sixth quarter). This examination will establish acceptable solo ability in at least one instrument or voice, including understanding of performance technique. At the time of this examination the student should have completed the department piano proficiency examination and the terminal ear-training examination. The student's academic standing will be reviewed at this time and the above factors will be weighed in advising the student on his occupational goals.

Graduation Proficiency. To be recommended for graduation, a music student should demonstrate to the music faculty mature acquaintance with performance styles, technique, and repertoire. All music majors will participate in departmental recitals to the satisfaction of the department and will present a graduation recital.

COURSES PRIMARILY FOR UNDERGRADUATE STUDENTS

99. IOWA STATE UNIVERSITY FESTIVAL CHORUS.
Cr. 0. F.
Open to students and staff. Performance at annual Christmas Festival.

100. FUNDAMENTALS OF MUSIC.
(1-2) Cr. 2. F.W.S. SSI.
Prerequisite: Elementary performing ability on an instrument or in voice.
Notation, recognition and execution of scales, intervals, triads, and rhythm; key signatures; time signatures; transposition.

102. INTRODUCTION TO MUSIC LITERATURE.
(2-1) Cr. 2. F.W.S. SSI.
Components of musical materials and form. Designed to expand the music listening experiences of the general student through greater awareness of differences in techniques of listening, performance media, and compositional styles.

104. INTRODUCTION TO LISTENING.
(2-3) Cr. 2. S.
Prerequisite: Departmental major status or permission of instructor.
Expansion of music listening activities through emphasis on materials of music, texture, form, style, and literature of major performance media.

111, 112, 113. BANDS.
Cr. 1 each time taken.
Open to all students who qualify. Concerts and annual tour in addition to playing for convocations and athletic events.
A: Symphony Band. F.W.S.
B: Concert Band. F.W.S.
C: Concert Jazz Band. F.W.S.
D: Marching Band. F.

119, 219, 319, 419. APPLIED MUSIC.
(1/2-1 or 1-1) Cr. 1 to 2 each time taken. F.W.S. SSI.
Prerequisite: Departmental major status or permission of instructor.
One 30-minute lesson per week, minimum weekly practice 5 hours. Two 30-minute lessons per week, minimum weekly practice 10 hours. Weekly seminar required.
A. Voice.
B. Piano.
C. Organ.
D. Strings.
E. Carillon.
F. Woodwinds.
G. Brass.
I. Percussion.

129, 229, 329. CLASS STUDY IN APPLIED MUSIC.
(0-3) Cr. 1 each time taken. F.W.S.
Prerequisite: Permission of department head.
Class study in instrument or voice. See Music 119, etc. for letter designation for various instruments.

130, 131, 132. CARDINAL KEYNOTE SINGERS.
(0-2) Cr. 1 each time taken. Yr.
Prerequisite: Open by audition to all students who are enrolled in another choral ensemble. Small mixed chorus featuring various forms of popular music. Performance on and off campus. May not be used to satisfy ensemble requirements for music majors.

133. BASIC VOICE TECHNIQUES.
(0-3) Cr. 1. S.
Techniques of vocal production: respiration, phonation, resonance, articulation, literature, language pronunciation, and performance.

142, 143. UNIVERSITY CHORUS.
(0-3) Cr. 1 each time taken. Yr.
Prerequisite: Open to all students by audition. Campus concerts. Rehearsals three times a week plus Festival Chorus.

146. SUMMER BAND.
(0-2) Cr. 1 each time taken. SSI.
Prerequisite: Open to all students who have performed on a wind or percussion instrument in band or orchestra. One concert presented in SSI.

151, 152, 153. ORATORIO CHORUS.
(0-3) Cr. 1 each time taken. Yr.
Prerequisite: Open to all students by audition. Concerts with ISU Symphony Orchestra. Rehearsals three times a week plus Festival Chorus.

161, 162, 163. IOWA STATE SINGERS.
(0-5) Cr. 1 each time taken. Yr.
Prerequisite: Open to all students by audition. Campus concerts and annual spring tour. Rehearsals five times a week plus Festival Chorus.

171, 172, 173. CHAMBER SINGERS.
(0-3) Cr. 1 each time taken. Yr.
Prerequisite: Open to all students by audition. Several appearances annually by a select group capable of advanced study and performing madrigals through modern music suitable to small ensemble.

175. SUMMER CHORUS.
(0-2) Cr. 1 each time taken. SSI.
Open to students, staff, and community.

181. 182, 183. SYMPHONY ORCHESTRA.
(0-2) Cr. 1 each time taken. Yr.
Prerequisite: Open to all students by audition. Concerts presented each quarter; annual tour fall quarter.
201, 202, 203. BASIC MATERIALS OF MUSIC.  
(3-2) Cr.  4 each Yr.  
Prerequisite: 201: 100 or departmental major status; 202: 201; 203: 202.  
201: Brief review of fundamentals. Harmonic and melodic materials of the common practice period. Application of these materials in sight-reading, ear training, keyboard, analysis, and writing.  
202: Continuation of 201. Techniques of harmonization, nonharmonic tones, modulation.  
203: Continuation of 201, 202. Chromatic harmony, smaller elements of formal structure, analysis, and creative work.

219. APPLIED MUSIC.  
(See Music 119.)

229. CLASS STUDY IN APPLIED MUSIC.  
(See Music 129.)

301, 302. OPERA STUDIO.  
(1-3) Cr. 1 to 3 each time taken. 301: F: 302: W.  
Prerequisite: Permission of instructor. Koupal. Interpretation and coaching of selected opera scenes and chamber operas, including informal and public presentations.

304, 305, 306. ADVANCED MATERIALS OF MUSIC.  
(3-2) Cr.  4 each Yr.  
Prerequisite: 203. Should be taken in sequence. White.  
Materials of 19th and 20th century music, musical form, instrumentation, introduction to orchestration and counterpoint in the 16th and 18th century styles. Application of these techniques and concepts in analysis and creative works.

310. VOCAL PEDAGOGY.  
(2-3) Cr.  3.  
Prerequisite: 319A or vocal proficiency examination.  
Supervised experience in teaching beginning voice students. Principles of vocal production.

319. APPLIED MUSIC.  
(See Music 119.)

321, 322, 323. ADVANCED ENSEMBLE.  
(3-0) Cr.  1 each Yr.  
Prerequisite: Advanced proficiency and performing ability. Permission of director and department head. Performance in ensembles which demand high proficiency. Open to a limited number of undergraduate and graduate students.

329. CLASS STUDY IN APPLIED MUSIC.  
(See Music 129.)

355, 356, 357. HISTORY OF MUSIC.  
(3-0) Cr.  3 each Yr.  
Prerequisite: 102 or 104. Should be taken in sequence. Bleyle.  

364. MUSIC IN EARLY CHILDHOOD EDUCATION.  
(3-0) Cr.  3.  

365. MUSIC IN ELEMENTARY EDUCATION.  
(3-0) Cr.  3. F.W.  

366. MUSIC IN GENERAL EDUCATION.  
(3-0) Cr.  3.  

367. PRACTICUM IN STRING INSTRUMENTS.  
(2-0) Cr.  2. F.  
Techniques and skills required for teaching of instruments. Examination of materials for school use. For the instrumental music specialist.

368. PRACTICUM IN WOODWIND INSTRUMENTS.  
(2-0) Cr.  2. W.  
Techniques and skills required for teaching of instruments. Examination of materials for school use. For the instrumental music specialist.

371. HISTORY OF CHURCH MUSIC.  
(3-0) Cr.  3. Alt. F, offered 1972.  
Prerequisite: Permission of instructor. Bley.  
Survey of the stylistic development of sacred music and the relationship of music to various theologies and liturgies.

373. HISTORY OF OPERA.  
(3-0) Cr.  3. Alt. F, offered 1971.  
Prerequisite: Permission of instructor. Koupal.  
Survey of periodic and national styles in opera.

375. HISTORY OF CHORAL MUSIC.  
Prerequisite: Permission of instructor. Pritchard.  
A survey of music written for vocal ensemble in historical context.

378. HISTORY OF ORGAN.  
(3-0) Cr.  3. Alt. 8, offered 1972.  
Prerequisite: Permission of instructor. Bley.  
Historical survey and practical study of the organ and its literature.

377. HISTORY OF SYMPHONIC MUSIC.  
Prerequisite: 102 or 104. Bley.  
A survey of music written for the large instrumental ensemble from the 17th century to the present. Score reading and listening.

380. SEMINAR IN MUSIC HISTORY.  
(3-0) Cr.  3. Alt. 8, offered 1972.  
Prerequisite: 355, 356, 357. Bley.  
Detailed studies in music history. Topics will include such divergent areas as the string quartets of Beethoven and Bartok, Wagner's Ring, and the music of Monteverdi. Topics will be selected by instructor and students.
Courses and Programs

382. INTRODUCTION TO MUSICOLOGY. (3-0) Cr. 3. Alt. F, offered 1971.
Prerequisite: 355, 356, 357. Bleyle.
Goals and achievements of musicology, introduction to bibliography and research in music.

419. APPLIED MUSIC. (See Music 119.)

465. MUSIC AND MOVEMENT. (2-0) Cr. 2. W.
Prerequisite: Classification in P.E.W. 260 or 376. Stark.
Concepts of music in relation to those of movement. Contributions of the public school music curriculum to basic movement and dance education.

466. MUSIC EDUCATION THROUGH PERFORMANCE. (3-1) Cr. 3. F.
Prerequisite: 310; 362A or 362B; 369.
Objectives, curriculum, methods and instructional materials appropriate for teaching vocal or instrumental music in elementary and secondary schools. Separate laboratories provide practical experience in vocal music for the instrumentalists and in instrumental music for the vocalists.
A. Vocal. Stark.
B. Instrumental. Swift.

467. ADVANCED PRACTICUM IN STRING INSTRUMENTS. (2-0) Cr. 2. W.
Prerequisite: 319D or 367.
Advanced techniques and skills required for teaching of instruments. Examination of materials for school use. For the instrumental specialist.

468. ADVANCED PRACTICUM IN WOODWIND INSTRUMENTS. (2-0) Cr. 2. W.
Prerequisite: 319F or 368. Messenger.
Advanced techniques and skills required for teaching of instruments. Examination of materials for school use. For the instrumental specialist.

469. ADVANCED PRACTICUM IN BRASS AND PERCUSSION. (2-0) Cr. 2. F.
Prerequisite: 319G or 319H or 369. Swift.
Advanced techniques and skills required for teaching of instruments. Examination of materials for school use. For the instrumental specialist.

480. GRADUATION RECITAL. Cr. 2. F,W,S,SS1.
Prerequisite: 419.
A public recital of literature which represents the student's accomplishment in his major applied area or in composition.

490. SPECIAL PROBLEMS. Cr. var. F,W,S,SS1.
Prerequisite: Permission of instructor.
A. Education. E. Literature.
C. Composition. H. Honors.
D. History. X. Recital Attendance.

*Offered on satisfactory-fail basis only.

NAVAL SCIENCE

Capt. James H. McGhee, USN, M.A., Head of Department

Associate Professors: Maj. John T. Garcia, USMC, A.B.; Cdr. Donald H. Gress, USN, M.A.


Instructor: Lcdr. Francis J. Davis, USNR, B.S.

The function of the Navy officer education program is to provide, by a permanent system of education in essential naval science and other academic subjects at civil educational institutions, a source from which qualified officers may be available for the Navy and the Marine Corps and their reserve components.

Students who enter the Navy officer education program may apply for either of two programs, the NROTC College Scholarship Program (financial assistance provided) or the College Program (nonscholarship/limited financial assistance). They pursue their studies like other students except that they meet certain requirements which will prepare them to serve as officers after graduation. Information is available from the professor of naval science, Iowa State University, concerning application, financial assistance, career opportunities, and active duty obligation. Also see Officer Education Programs in this catalog.

While in the program, the student will participate in summer at-sea training cruises with pay and may take part in extracurricular activities which help him to decide which field of the Navy or Marine Corps he wishes to enter. These activities include three cruises for scholarship and one for nonscholarship students, several student societies, and indoctrination trips to a naval air station and Marine Corps base. In addition, a Navy-subsidized flight instruction program, conducted by the Iowa State University Flight Service, enables selected students to earn a private pilot's license during his junior or senior year in school.
Undergraduate Study

Naval science courses are primarily for those students in the NROTC program. Other students may enroll in naval science courses with approval of the head of department.

Students enrolled in the NROTC program must fulfill the following requirements:

1. NS 111, 112, 113, 211, 212, 213, 311, 312, 313, 411, 412, and 413 (A or B). Marine Option Students will substitute NS 311M, 312M, 313M, 411M, 412M, and 413M for the 300 and 400 series listed above. (2) History 387A and 387B, and either Political Science 251, 422A, 422B, or 458. (3) By the end of the junior year, all students must have completed one year of calculus or statistics, one quarter of computer science, and one year of physics, chemistry, or biological or earth science.

NROTC students are not required to major in naval science. They may pursue any major leading to a bachelor's degree.

In addition to completing all naval science courses, students majoring in naval science must take the following courses:

Math. 110, 111, 112; statistics, 5 credits; Com.S. 201, 202, 203; Phys. 111, 112, 113; Chem. 141, 142; Hist. 387A, 387B; Psych. 101; geography, 3 credits; and Pol.S. 458.

Naval science majors may substitute courses in computer science, physics, and chemistry with the approval of head of department.

Marine Corps option students majoring in naval science will elect 300 and 400 series marine option courses in lieu of 300 and 400 series naval science courses.

For basic undergraduate curriculum requirements, see Sciences and Humanities, Curriculum.

COURSES PRIMARILY FOR UNDERGRADUATE STUDENTS

Courses in Naval Science

111. PRINCIPLES OF NAVAL ORGANIZATION. (3-2) Cr. 3. F.
Organization, responsibilities, and capabilities of a modern navy with emphasis on the junior officer's role in the Naval Service.

112. PRINCIPLES OF NAVAL MANAGEMENT. (3-2) Cr. 3. W.
Prerequisite: 111.
Fundamental concepts and principles of naval organization and management including essential elements of leadership.

113. INTRODUCTION TO NAVAL SHIP SYSTEMS. (3-2) Cr. 3. S.
Prerequisite: 111.
Naval ship structure, compartmentation, propulsion, auxiliary power, interior communications, control systems, stability, and damage control.

211, 212, 213. SEAPOWER AND MARITIME AFFAIRS SEMINAR. (1 1/2-2) 211, 212: Cr. 1 each; 213: Cr 2. Yr.
Laboratory required for NROTC students only.

311, 312, 313. NAVIGATION AND NAVAL OPERATIONS. (3-2) Cr. 3 each. Yr.
311: Navigation procedures including piloting, dead reckoning, and radar; theory of celestial navigation. 312: Celestial navigation and solution of celestial navigation problems, theory of relative motion, maneuvering instructions and problems. 313: Electronic navigation, operations analysis, rules of the road.

411. NAVAL WEAPONS SYSTEMS. (3-2) Cr. 3. F.
Weapons systems and the systems approach, including basic principles of naval weapons and fire control.

412. NAVAL WEAPONS SYSTEMS. (3-2) Cr. 3. W.
Dynamics of the basic components of weapons control systems. Further development of the basic principles that underlie modern naval weapons systems.

413A. NAVAL WEAPONS SYSTEMS. (3-2) Cr. 3. S.
Prerequisite: Math. 112, Phys. 113.
Principles of selected phases of the weapons control problem, including propulsion systems, trajectories, flight paths, and damage criteria. Methods of solution of the weapons system control problem. Design and testing of weapons components including warheads, fuses, guidance and control. Procedures for evaluating weapons system effectiveness.

413B. NAVAL WEAPONS SYSTEMS. (3-2) Cr. 3. S.
Similar to 413A. For students without preparation in calculus.

Courses in Marine Option

311M. EVOLUTION OF LAND CONFLICT. (3-2) Cr. 3. Alt. F, offered 1971.
Evolution of land warfare from Alexander the Great to the Civil War.

Prerequisite: 311M.
Historical development of United States military strategy and tactics from the Civil War to the present.
NUCLEAR ENGINEERING

Glenn Murphy, Ph.D., Head of Department

Professors: Richard A. Danofsky, Ph.D.; Donald M. Roberts, Ph.D.
Associate Professors: Paul W. Barcus, Ph.D.; Benjamin M. Ma, Ph.D.; Alfred F. Rohach, Ph.D.
Assistant Professors: Achilles G. Adamantiades, Ph.D.; Howard Bell, Ph.D.; Vishvanath D. Chitnis, Ph.D.; Raymond T. Greer, Ph.D.; Richard A. Hendrickson, Ph.D.; William D. Leech, Ph.D.; Michael R. Ringham, Ph.D.
Instructor: Virginia P. Denisen, B.S.

Undergraduate Study

Nuclear engineering is a graduate program, hence the Bachelor of Science degree is not offered in this field. However, an integrated 5-year program leading to a bachelor's degree with a major in engineering science and a master's degree with a major in nuclear engineering is available. Qualified students from other curricula may be admitted for graduate majors in nuclear engineering.

A survey course, Nuc.E. 474, is available at the undergraduate level.

Graduate Study

The department offers work for the degrees Master of Science, Master of Engineering, and Doctor of Philosophy with major in nuclear engineering. Minor work in nuclear engineering and in engineering similitude is offered to students taking major work in other departments.

Prerequisite to major work is the completion of a curriculum substantially equivalent to that required of undergraduate students in engineering at this institution. It is recommended that students contemplating graduate studies in nuclear engineering include courses in modern physics, heat transfer, chemistry beyond freshman chemistry, and mathematics beyond differential equations as part of their undergraduate preparation.

A foreign language is not required for the degrees Master of Science or Master of Engineering. For the degree Doctor of Philosophy a reading knowledge of one foreign language is required. This requirement may be met by (1) attaining a minimum grade of B in 15 credits of foreign language at the collegiate level, or (2) demonstrating in a departmental examination a reading knowledge of a foreign language in the student's field of specialization.

COURSE PRIMARILY FOR UNDERGRADUATE STUDENTS

474. INTRODUCTION TO NUCLEAR ENGINEERING.
(3-0) Cr. 3. F.W.S.
Prerequisite: M.E. 344, Math. 321 or permission of instructor.

Basis and problems of nuclear power development; considerations in nuclear reactor design; radiation hazards and shielding; use of radioisotopes in industry.
COURSES PRIMARILY FOR GRADUATE STUDENTS, major or minor, open to qualified undergraduates

501. ELEMENTS OF NUCLEAR ENGINEERING. (3-0) Cr. 3. F.
Prerequisite: M.E. 321 or 344.

502. NUCLEAR REACTOR MATERIALS. (3-0) Cr. 3. W.
Prerequisite: 501 and permission of instructor.
Mechanical and nuclear properties of solid, fluid, and gaseous reactor materials. Radiation effects.

503. NUCLEAR REACTOR MATERIALS. (3-0) Cr. 3. S.
Prerequisite: 502.
Mechanical and nuclear properties of solid and fluid reactor materials. Thermal and structural problems in reactors.

504. NUCLEAR REACTOR DESIGN. (1-6) Cr. 3. S; or (3-15) Cr. 8. 12 wk. SS.
Prerequisite: Credit or classification in 537. Engineering aspects of reactor design and use of nuclear power.

506. ADVANCED PROPERTIES OF ENGINEERING MATERIALS. (3-0) Cr. 3. F.
Prerequisite: E.Scl. 351.
Influence of structure and environment on the mechanical properties of engineering materials. Types of imperfections and their effects. Control of properties.

507. RADIATION SAFETY. (3-0) Cr. 3. W.
Prerequisite: Permission of instructor.
Sources and nature of radiation, measurement techniques, somatic and genetic effects, AEC regulations, and safety procedures.

510. NUCLEAR RADIATION MEASUREMENTS. (1-4) Cr. 3. W.
Principles of nuclear radiation detection and measurement, ionization chambers, proportional counters, geiger tubes. Counting circuits. Applications to engineering problems.

511. NUCLEAR FUELS AND WASTES. (3-0) Cr. 3. S.
Prerequisite: Permission of instructor.
Preparation of reactor fuels and handling of radioactive wastes.

512. REPROCESSING NUCLEAR FUELS. (3-0) Cr. 3. S.
Prerequisite: 511.
Principles of nuclear reprocessing methods.

517, 518, 519. ANALYTICAL METHODS IN NUCLEAR ENGINEERING. (3-0) Cr. 3 each Yr.
Prerequisite: 517: Math. 322; 518: 517; 519: 518.

524. NUCLEAR POWER ECONOMICS. (3-0) Cr. 3. S.
Prerequisite: 501.
Economics of direct-cycle and indirect-cycle nuclear reactor systems, fuel cells, direct conversion. Comparisons with wind, tidal, solar, geothermal, hydrothermal, and fossil fuels. Direct secondary effects.

534. REACTOR STRESS ANALYSIS. (3-0) Cr. 3.
Prerequisite: E.M. 324, Math. 321.
Analysis of stresses in reactor elements and structures. Thermal stresses in fuel elements and reactor vessels. Design of containment structures.

535. NUCLEAR PHYSICS FOR ENGINEERS. (4-0) Cr. 4. F.
Prerequisite: Math. 321, Phys. 223.
Atomic and nuclear structure, introduction to quantum theory, fundamental particles; isotopes; alpha, beta and gamma radiation.

536, 537. ELEMENTARY REACTOR THEORY. (3-0) Cr. 3 each W.S.
Prerequisite: 535 or Phys. 483 or 593; Math. 322.
Diffusion of neutrons, homogeneous and heterogeneous reactors, reactor control, perturbation theory, and transport theory.

541, 542, 543. REACTOR LABORATORY. (1-6) Cr. 3 each F.W.S.
Prerequisite: 510.
Laboratory problems involving the nuclear reactor.

554. RADIOISOTOPES IN ENGINEERING. (2-4) Cr. 4. F.
Prerequisite: Permission of instructor.
Principles of industrial utilization of radioisotopes and applications in engineering.

561, 562. NUCLEAR REACTOR DYNAMICS. (3-2) Cr. 4 each W.S.
Prerequisite: 537, 540.
Principles of reactor control and operation. Reactor kinetics with time varying inputs, the reactor as a control element, reactor performance in a power reactor system, stochastic methods for measurements of reactor parameters.

568. NUCLEAR SAFETY. (3-0) Cr. 3. S.
Prerequisite: 561.
AEC regulations, safety analyses, assessments of magnitudes and consequences of nuclear incidents, Reactor siting, safeguards, containment.

571, 572. THERMONUCLEAR THEORY. (3-0) Cr. 3 each W.S.
Prerequisite: 538.

581, 582, 583. REACTOR ANALYSIS. 581: (3-0); 582: (2-2); 583: (2-2) Cr. 3 each Yr.
Prerequisite: 637, Math. 408.
Application of numerical-analysis techniques to thermal and fast reactors.

590. SPECIAL TOPICS. (2 to 5-0) Cr. 2 to 5.

591, 592. OCEAN ENGINEERING SIMULATION. (3-0) Cr. 3 each W.S.
Prerequisite: E.Scl. 481 or 484.
Development of mathematical and laboratory models and analogs for the solution of nuclear engineering problems associated with the ocean environment. Coastal and harbor applications. Deep-sea applications.
COURSES FOR GRADUATE STUDENTS, major or minor

602. RADIATION SHIELDING.
(3-0) Cr. 3.
Prerequisite: 504, 510, 536.
Design of shielding systems for protection against gamma rays and neutrons. Applications to nuclear reactors, cooling systems, processing equipment and other engineering units.

606. NUCLEAR REACTOR FUELS.
(3-0) Cr. 3. Alt. W. as arr.
Prerequisite: 506.

611, 612, 613. ADVANCED REACTOR THEORY.
(3-0) Cr. 3 each. Yr.
Prerequisite: 537.
Advanced theory of nuclear reactors.

620. SEMINAR.
(2-2) Cr. 2, F.
Prerequisite: Permission of instructor.
Current literature in nuclear engineering.

624. ADVANCED NUCLEAR ENGINEERING.
(2-2) Cr. 3 F.
Prerequisite: 504 or permission of instructor.
Exploitation of new concepts in nuclear engineering. Reactor systems, thermonuclear developments, fission, fusion, and mass-energy transducers.

651, 652, 653. INTERACTION OF MATERIALS AND RADIATION.
(3-2) Cr. 4 each. Alt. Yr. as arr.
Prerequisite: 502, 536.
Interaction between alpha, beta, gamma and neutron radiation and materials; absorption and scattering processes, influence on properties, shielding.

654. SELECTED TOPICS IN RADIOISOTOPE PRODUCTION AND APPLICATIONS.
(3-0) Cr. 3 each. Alt. Yr. as arr.
Prerequisite: 554.
A series of one-term courses covering in depth such topics as radioisotope production, neutron activation analysis, neutron radiography, radioisotope power generating systems and tracer applications current in engineering research and development.

684, 685, 686, 687. SIMILITUDE IN ENGINEERING.
(2-2) Cr. 3 each. 684: F; 685: W; 686: S; 687: F.
Prerequisite: Permission of Instructor.
Principles of dimensional analysis and their application to design of models. Design, testing, and interpretation of models. True and distorted models, linear and nonlinear models, analogies. Applications.

699. RESEARCH.

OFFICER EDUCATION PROGRAMS

Iowa State University offers programs for the preparation of officers for the Army, Navy, and Air Force.

The purpose of these programs is to provide reserve and short-term active duty officers, and longer-term regular career officers. All three services require a period of active duty long enough to encourage officers to make a career of military service. Consequently, Iowa State University views these Officer Education Programs as ones which may prepare students for a military career.

Financial assistance grants (scholarships) for up to four years are available to participants in the Army, Navy, and Air Force four-year ROTC programs. Selection criteria are based on an individual's leadership potential as well as his academic record. Applications for four-year financial assistance grants should be submitted by high school seniors in accordance with the schedules of the individual services. Applications for three-, two-, and one-year financial assistance grants are accepted during the individual's first, second, and third year of ROTC respectively. For those who are chosen, all expenses for tuition (including out-of-state), books, laboratory fees, and monthly subsistence allowances are paid by the United States government for the term of the financial assistance grant.

ROTC is recognized as a subject matter area of specialization. Three categories of credit allocation are recognized:

I. A student can major in Navy ROTC in the College of Sciences and Humanities, applying 30 credits toward the major.

II. In colleges where minors are part of the curriculum, 18 credits of advanced ROTC may be applied toward the minor. Ten credits of basic ROTC may be applied toward the elective requirement.

III. If a student does not select ROTC as a major or minor, ROTC credits may, at the discretion of the college and the department, be applied toward the elective requirement.

For specific courses and programs see also Air Force Aerospace Studies, Military Science, and Naval Science.
OUTDOOR RECREATION RESOURCES

Henry Webster, Ph.D., Professor in Charge

For undergraduate curriculum in outdoor recreation resources leading to the degree Bachelor of Science, see College of Agriculture, Curricula.

This curriculum is for those who wish to manage natural resources for outdoor recreation. The resources might include land under private ownership developed for recreation, or publicly owned parks, forests, rivers, lakes, or coastal areas. The curriculum is focused particularly on preparation for recreation and park management, and recreation-systems planning, with other opportunities for concentration on allied and supporting disciplines such as communications, interpretation, biology, forestry, fish and wildlife biology, social sciences, and related fields.

COURSES PRIMARILY FOR UNDERGRADUATE STUDENTS

101. INTRODUCTION TO OUTDOOR RECREATION RESOURCE MANAGEMENT. (3-3) Cr. 4. W.
   Evaluation of trends in demand for outdoor recreation services; implication for current and future management of public and private forest and related lands and water resources; problems, policy issues.

110. ORIENTATION. (1-0) Cr. R; F.
   Discussion of current topics related to the development of resources for outdoor recreation.

360. PARK AND RECREATION MANAGEMENT. (For. 360) (3-0) Cr. 3. S.
   The principles of managing resources and people in outdoor recreational use; the protection and interpretation of natural resources including land and water; development of policies and programs involving both mass and dispersed forms of recreation.

451. MANAGEMENT OF OUTDOOR RECREATION RESOURCES: ECONOMICS AND MARKETING. (2-3) Cr. 3. S.
   Prerequisite: For. 300, Econ. 242.
   Economic factors and analytical methods influencing decisions by outdoor-recreation-resource agencies and firms, influence of population, income, and related economic and social factors.

452. MANAGEMENT OF OUTDOOR RECREATION RESOURCES: QUANTITATIVE ANALYSIS. (3-3) Cr. 4. F.
   Prerequisite: 451, Econ. 242, Com.S. 201.
   Methods for rigorously identifying and specifying problems involved in management, protection, and use of outdoor recreation resources. Application of mathematical and statistical models in solving these managerial problems. Design and collection of information for use in these models.

453. MANAGEMENT OF OUTDOOR RECREATION RESOURCES: POLICY AND ADMINISTRATION. (3-0) Cr. 3. W.
   Prerequisite: 452, Pol.S. 215, senior classification.
   Analysis of the political, institutional, and administrative processes involved in formulation of public and private policy concerning major outdoor-recreation-resource issues.

454. MANAGEMENT OF OUTDOOR RECREATION RESOURCES: INTEGRATED CASE STUDIES. (1-4) Cr. 3. S.
   Prerequisite: 453.
   Organization and administration of major outdoor recreation resources. Emphasis on case studies to illustrate methods for synthesizing the economic, mathematical, biological, political, and administrative principles discussed in the preceding courses.

490. SPECIAL PROBLEMS.
   Cr. 1 to 6 each time elected.
   Prerequisite: Junior classification, permission of instructor.

PHILOSOPHY

Emerson W. Shideler, Ph.D., Chairman of Department

Professor: Richard J. Van Iten, Ph.D.
Associate Professor: Paul W. Hollenbach, Ph.D.
Assistant Professors: David F. Haight, Ph.D.; Karl A. Kottman, Ph.D.; Ted J. Solomon, Ph.D.
Instructors: John P. Casey, M.A.; Tyrone T. L. Lal, C. Phil.

Undergraduate Study

For the undergraduate curriculum in sciences and humanities, major in philosophy, leading to the degree Bachelor of Arts, see Sciences and Humanities, Curriculum.

Philosophy is the study of the dominant ideas, values, and ways of thinking that control
the specialized search for knowledge, and which underlie cultural, social, and political processes. The first contribution of philosophical study is to broaden the student's educational experience and to facilitate more effective participation in decision making. Introductory courses in philosophy and religion survey dominant ideas as they apply to all fields of knowledge. Advanced courses examine in depth more specific topics in the philosophical and religious traditions of both Western and Oriental cultures.

An undergraduate major in philosophy should have a broad background in the sciences and humanities. The major program includes a thorough acquaintance with the history of philosophy and further concentration in historical and systematic issues, or logic and philosophy of science, or religion.

An undergraduate major in philosophy can prepare the student for graduate study in philosophy or theology, and also for further study of law, history, political science, political and social theory, and literature.

Graduate Study

The department offers courses for graduate minor credit in philosophy as supporting work to other fields.

Courses open to graduate students for minor credit only: 321, 322, 341, 342, 343, 344, 351, 352, 353, 357, 365, 370, 430, 431, 455, 458, 460, 461, 462, 470, 480, 481, 490.

COURSES PRIMARILY FOR UNDERGRADUATE STUDENTS

200. INTRODUCTION TO STUDY OF RELIGION.
   (3-0) Cr. 3. F.W.S.
   Understanding of what religion is, how religion functions in the life of individuals and societies, and how religions differ, what the variety of religious forms is. Study of religious beliefs, literatures, institutions, and practices.

231. INTRODUCTORY ETHICS.
   (3-0) Cr. 3. F.W.S.
   Historical and critical introduction to principal ethical systems. Concepts of the nature of good, right, and duty. Standards of public and private action.

260. INTRODUCTION TO PHILOSOPHY.
   (3-0) Cr. 3. F.W.S.
   General introduction to philosophy both for those desiring a single terminal course and for those intending to proceed further. Systematic examination of some main problems in metaphysics, theory of knowledge and ethics. Emphasis upon our philosophical tradition and upon critical standards of judgment.

270. INTRODUCTORY LOGIC.
   (3-0) Cr. 3. F.W.S.SS.
   Forms of logical inference; truth, validity, definition, proof; logic as an aid to clear thinking; the relation of logic to language; the logical structure of reasoning in science.

321. THE OLD TESTAMENT.
   (3-0) Cr. 3. F.W.
   Prerequisite: 200.
   Major books in the Old Testament within the framework of their historical background with particular attention to the development of the great religious and ethical ideas.

322. THE NEW TESTAMENT.
   (3-0) Cr. 3. W.
   Prerequisite: 200.
   The development of Christian thought and organization to the close of the New Testament period.

341. ANCIENT AND MEDIEVAL PHILOSOPHY.
   (4-0) Cr. 4. F.
   Prerequisite: 260.
   An account of the rise of critical thought in early Greek and Christian schools of philosophy. Readings from Plato, Aristotle, the Stoics and Epicureans, Augustine, and Aquinas.

342. MODERN PHILOSOPHY.
   (4-0) Cr. 4. W.
   Prerequisite: 260.
   The historical development of philosophical thought from the Renaissance through the eighteenth century. Readings from Bacon, Hobbes, Descartes, Spinoza, Leibniz, Locke, Berkeley, Hume, and Kant.

343. NINETEENTH CENTURY PHILOSOPHY.
   (4-0) Cr. 4. S.
   Prerequisite: 342.
   Philosophical developments in the nineteenth century.

344. TWENTIETH CENTURY PHILOSOPHY.
   (4-0) Cr. 4. F.
   Prerequisite: 342.
   Philosophical developments in the twentieth century: realism, pragmatism, positivism, existentialism, analytic philosophy.

351. RELIGIONS OF WESTERN ASIA.
   (3-0) Cr. 3. F.
   Prerequisite: 200 or 260.
   Introduction to the ancient religions of Mesopotamia and the Mediterranean basin as background for understanding the historical development of Judaism, Zoroastrianism, and Islam.

352. RELIGIONS OF SOUTHERN AND SOUTHEASTERN ASIA.
   (3-0) Cr. 3. W.
   Prerequisite: 200 or 260.
   Introduction to the basic religious patterns and teachings of Indian religions: Hinduism, Theravada Buddhism, Jainism, Sikhism.

353. RELIGIONS OF EAST ASIA.
   (3-0) Cr. 3. S.
   Prerequisite: 200 or 260.
   Introduction to the religions of China, Korea, and Japan: Confucianism, Taoism, Shinto, and the schools of Mahayana Buddhism such as Amida and Zen.
PHILOSOPHY OF RELIGION.
(4-0) Cr. 4. F.S.
Prerequisite: 260.
Application of principles of philosophical method to basic issues of religious belief, emphasizing problems in religious knowledge, theistic claims, relation of religion and science, skeptical attacks upon religion. Illustrative material drawn from both Christianity and non-Christian world religions.

INTRODUCTION TO EXISTENTIALISM.
(4-0) Cr. 4. F.W.
Prerequisite: 260.
Systematic examination of the views of such men as Kierkegaard, Marcel, Heidegger, and Sartre.

SYMBOLIC LOGIC.
(3-0) Cr. 3. F.W.S.
Introduction to propositional and predicate calculi as well as intuitive set theory. Some applications to philosophy and the foundations of mathematics.

AESTHETICS.
(4-0) Cr. 4. S.
Prerequisite: 260.
An examination of some philosophical problems that arise in interpreting and evaluating the arts with particular attention to some representative theories of the nature of art, artistic creation, aesthetic experience, standards of taste, and criticism.

CONTEMPORARY ETHICAL THEORY.
(4-0) Cr. 4. W.
Prerequisite: 231.
Theoretical and normative issues in contemporary ethical thinking.

CHRISTIAN THOUGHT.
(3-0) Cr. 3. W.
Prerequisite: 200 or 260.
Historical development of Christian philosophy and theology; significant issues in the formulation of the creeds, the continental and English reformations, the Counter Reformation, the modern secularist attacks upon religion. Distinctive features of Roman Catholicism, Eastern Orthodoxy, Protestantism. Emphasis upon the interaction between Christian thought and secular, cultural, and philosophic movements to show significance and influence of Christianity in the formation of Western culture and philosophy.

CONTEMPORARY CHRISTIAN THEOLOGY.
(3-0) Cr. 3. S.
Prerequisite: 200 or 260.
Selected theologians, and theological issues in contemporary Christianity, both Protestant and Roman Catholic.

CONTINENTAL RATIONALISM.
(4-0) Cr. 4. Alt. F. offered 1971.
Prerequisite: 342.
Critical exposition of seventeenth century rationalism as developed by Descartes, Spinoza, and Leibniz.

THE EMPIRICIST TRADITION.
(4-0) Cr. 4. Alt. F. offered 1972.
Prerequisite: 342.
Critical exposition of British empiricism as developed by Locke, Berkeley, and Hume.

SEMINAR IN EPISTEMOLOGY AND METAPHYSICS.
(4-0) Cr. 4. May be repeated for credit with permission of instructor. W.
Prerequisite: 344.
Issues in epistemology and metaphysics. Topics vary each time offered.

PHILOSOPHICAL ISSUES IN LOGIC.
(4-0) Cr. 4. F.
Prerequisite: 370.
Philosophical problems in logical theory and foundations of mathematics.

PHILOSOPHY OF SCIENCE.
(4-0) Cr. 4 each. 480: F; 481: W.
Prerequisite: 480: 260 or 270; 481: 480.
Problems in philosophy of science. Analysis of explanation, confirmation, meaning of scientific principles, metaphysical implications of scientific theories, justification of induction.

SPECIAL PROBLEMS.
Cr. 2 to 5 each time taken.
Prerequisite: Six credits in philosophy and permission of instructor. Approval of department head must be obtained prior to registration. Guided reading and research on special topics selected to meet needs of advanced students. H. Honors.

PHYSICAL EDUCATION FOR MEN

James P. Reid, Ed.D., Head of Department


Assistant Professors: Glendon R. Anderson, B.S.; Jerome Barland, M.S.; Raymond Bickerstaff, M.Ed.; Wallace W. Hutchison, M.S.; John T. Majors, B.S.; Christopher D. Murray, M.S.; Arch Steel, M.A.

Undergraduate Study

Two curricula, one leading to the degree Bachelor of Science, the other to the degree Bachelor of Arts or Bachelor of Science, are available to the student. The curriculum in Sciences and Humanities with a major in physical education for men, leading to the degree Bachelor of Science, is described in the section College of Sciences and Humanities under the heading Curriculum in Sciences and Humanities. The second curriculum, leading to the degree Bachelor of Arts or Bachelor of Science, is outlined in the same section under the heading Curriculum in Physical Education for Men. Both curricula provide a general background in physical education and prepare the student to teach physical education and to coach interscholastic athletics in the secondary schools. An option in the Curriculum in Physical Education for Men leads to the Bachelor of Arts degree and prepares the student to direct recreational programs for schools, institutions, camps, industries and communities. For teaching and coaching, see Index, College of Education.

The department also provides basic instruction for undergraduates and administers a competitive program in intramural sports.

The basic instruction program promotes the health, organic vigor, and good physical-exercise habits of the student. In the program, each student develops a reasonable degree of skill in a variety of leisure-time activities for immediate and later recreational appreciation and enjoyment.

The Intramural program provides the opportunity for the student to participate in many competitive sports: archery, baseball, basketball, chess, fencing, golf, handball, hockey, horse-shoe pitching, indoor and outdoor track, softball, swimming, table tennis, tennis, touch football, volleyball, and wrestling.

Courses at the 100 level must be used by men to satisfy the physical education requirement of the University.

PEM 101 is prerequisite to all other 100-level courses.

COURSES PRIMARILY FOR UNDERGRADUATE STUDENTS

Basic Instruction Program Courses

Credits used to satisfy the physical education requirement of the University must be earned in the following courses:

101. FOUNDATIONS OF PHYSICAL EDUCATION.
(0-2) Cr. 1. F.W.S.
Classification and orientation in physical education activities.

110. PRESCRIBED INDIVIDUAL ACTIVITIES.
(0-2) Cr. 1. F.W.S.
Prerequisite: Prescription of Student Health Services.
Activities are assigned in accordance with the student's need in one of the following categories:
A. A sport adapted to the student's physical capacity and interest.
B. A program of exercise for physical rehabilitation following illness or accident.
C. A program of exercise designed toward the correction of a physical defect.

111. BEGINNING SWIMMING I.
(0-2) Cr. 1. W.S.S.S.

112. BEGINNING SWIMMING II.
(0-2) Cr. 1. F.W.S.S.

117. FOLK DANCE.
(P.E.W. 117) See Physical Education for Women.

118. SQUARE DANCE.
(P.E.W. 118) See Physical Education for Women.

125. VOLLEYBALL I.
(0-2) Cr. 1. F.W.S.

133. FENCING I.
(0-2) Cr. 1. F.W.S.

135. WRESTLING I.
(0-2) Cr. 1. F.W.

141. ARCHERY.
(0-2) Cr. 1. F.W.S.S.S.

142. BADMINTON.
(0-2) Cr. 1. F.W.S.

144. BAITCASTING.
(0-2) Cr. 1. F.S.

147. BOWLING.
(0-2) Cr. 1. F.W.S.

149. GOLF I.
(0-2) Cr. 1. F.S.S.S.

151. GYMNASTICS I.
(0-2) Cr. 1. F.W.S.

153. HANDBALL.
(0-2) Cr. 1. F.W.S.

155. TENNIS I.
(0-2) Cr. 1. F.S.S.S.

157. PADDLEBALL AND SQUASH.
(0-2) Cr. 1. F.W.
Elected credits beyond the University requirement may be selected from the courses listed previously or from the following courses:

113. WATER POLO AND RELATED SPORTS.
   (0-2) Cr. 1. W.S.

114. LIFE SAVING.
   (0-2) Cr. 1. W.S.SS.

115. WATER SAFETY.
   (0-2) Cr. 1. F.W.S.SS.
   Leads to certification as a Red Cross water safety instructor.

120. BEGINNING MODERN DANCE.
   (P.E.W. 120) See Physical Education for Women.

122. BASKETBALL.
   (0-2) Cr. 1. W.

126. VOLLEYBALL II.
   (0-2) Cr. 1. W.S.
   Prerequisite: 200.

134. FENCING II.
   (0-2) Cr. 1. W.S.
   Prerequisite: 133.

136. WRESTLING II.
   (0-2) Cr. 1. F.W.

145. BAITCASTING CRAFTS.
   (0-2) Cr. 1. F.W.
   Prerequisite: 144.

150. GOLF II.
   (0-2) Cr. 1. F.S.SS.

### Professional Program Courses

#### Courses primarily for physical education option:

200. INTRODUCTION TO PHYSICAL EDUCATION.
   (3-0) Cr. 3. F.S.
   Basic philosophy and objectives of physical education; essential interests, abilities, personal characteristics, and professional qualifications; planning for careers as qualified teachers.

205. SUPERVISED TEACHING IN PHYSICAL EDUCATION.
   (1-2) Cr. 1. F.W.
   Prerequisite: 200, sophomore classification.
   Pre-student-teaching experience. Offered on a satisfactory-fail basis only.

230. 231, 232. SPORTS OFFICIATING.
   (1-2) Cr. 2 each. 230: F; 231: W; 232: S.SS.
   Philosophy and principles; qualifications of an official, techniques of officiating in athletic contests. Practical experience in the intramural program.

305. SUPERVISED TEACHING IN PHYSICAL EDUCATION.
   (1-2) Cr. 2. F.W.S.SS.
   Prerequisite: 205, junior classification, admittance to teacher education program. Pre-student-teaching experience.

330. HISTORY AND PRINCIPLES OF PHYSICAL EDUCATION.
   (6-0) Cr. 5. F.W.SS.
   Prerequisite: 205, Educ. 204, junior classification.
   Evolution of modern physical education; influence of prevailing philosophies on current principles and practices.

340. ORGANIZATION AND ADMINISTRATION OF INTRAMURAL ATHLETICS.
   (3-0) Cr. 3. W.SS.
   Prerequisite: 330.
   Conduct and direction with special emphasis on the secondary level.

405. SUPERVISED TEACHING IN PHYSICAL EDUCATION.
   (1-2 and arr.) Cr. 3. F.W.S.SS.
   Prerequisite: 305, 497.
   Pre-student-teaching experience.

490. SPECIAL PROBLEMS.
   Cr. var.
   Prerequisite: 2.3 grade-point average, senior classification or permission of department head.
   A. Coaching Sports.
   B. Physical Education.
   C. Recreation.
   D. Honors.

494. PHYSICAL EDUCATION CURRICULUM: DESIGN AND ADMINISTRATION.
   (5-0) Cr. 5. W.S.SS.
   Prerequisite: 497, senior classification.
   Physical education curriculum and current administrative policies, procedures, and practices in secondary schools.

496. TESTS AND MEASUREMENT IN PHYSICAL EDUCATION.
   (2-2) Cr. 3. S.
   Prerequisite: Senior classification in physical education for men curriculum, Psych. 440.
   Tests and measurement which aid in classification, aptitude prediction, and evaluation of performance.

497. METHODS OF TEACHING PHYSICAL EDUCATION.
   (2-3) Cr. 3. W.S.
   Prerequisite: 330, Psych. 333, admittance to teacher education program.
   Application of general educational methods to physical education. Special methods of teaching activities not covered in 314, 315, 316, 317.
Courses primarily for recreation option:

201. AN INTRODUCTION TO RECREATION.  
(3-0) Cr. 3. F.S.S.S.  
Recreation in total personal development; requirements of recreation leadership and its vocational opportunities.

283. LEADERSHIP IN RECREATION.  
(0-3 or 6) Cr. 1 or 2. F.W.S.S.  
Prerequisite: 201, sophomore classification.  
Observation and practice in community recreation groups. Offered on a satisfactory-fall basis only.

350. SOCIAL RECREATION.  
(1-4) Cr. 3. W.  
Prerequisite: 201.  
Leadership techniques in teaching low organized games; rhythm activities and social mixers.

351. OUTDOOR RECREATION.  
(1-4) Cr. 3. F.S.S.  
Prerequisite: 201.  
Conservation and use of outdoor facilities and resources; methods of leadership in camping; camping skills.

Courses primarily for coaching endorsement option:

212. GYMNASTICS TECHNIQUES.  
(1-4) Cr. 3. W.S.S.S.  
Theory of activities, including tumbling and apparatus.

214. FOOTBALL TECHNIQUES.  
(1-4) Cr. 3. F.S.  
Fundamental skills and methods.

215. BASKETBALL TECHNIQUES.  
(1-4) Cr. 3. W.  
Fundamental skills and methods.

218. TRACK AND FIELD TECHNIQUES.  
(1-4) Cr. 3. S.S.S.  
Fundamental skills and methods. Rules and officiating.

219. BASEBALL TECHNIQUES.  
(1-4) Cr. 3. S.  
Fundamental skills and methods.

218. SWIMMING TECHNIQUES.  
(1-4) Cr. 3. W.S.  
Prerequisite: 112.  
Fundamental skills, life saving, and methods of teaching.

219. WRESTLING TECHNIQUES.  
(1-4) Cr. 3. W.  
Skills and methods of teaching.

314. FOOTBALL COACHING.  
(3-0) Cr. 3. W.S.S.  
Prerequisite: 214, junior classification.  
History, rules, theory, methods.

352. RECREATION PROGRAM DEVELOPMENT.  
(2-2) Cr. 3. W.  
Prerequisite: 201, sophomore classification.  
Principles and procedures.

353. ORGANIZATION AND ADMINISTRATION OF RECREATION.  
(3-0) Cr. 3. S.  
Prerequisite: 352, junior classification.  
Techniques of leadership; organizational and administrative procedures in recreation programs.

483. LEADERSHIP IN RECREATION.  
(0-3 or 6) Cr. 1 or 2. F.W.S.S.  
Prerequisite: 352, 353, junior classification.  
Field work in a responsible position of recreation leadership in community recreation groups.

PHYSICAL EDUCATION FOR WOMEN

Barbara E. Forker, Ph.D., Head of Department

Professors: Germaine G. Guiliet, Ed.D.; Betty L. Toman, M.S.

Assistant Professors: Madge H. Bowers, B.S.; Darlene Conover, M.A.; Luzonne Darr, M.A.; Betty A. Keenan, M.A.; Patricia Phemister, Ed.S.

Undergraduate Study

The department of physical education for women offers work for the Bachelor of Science degree with a major in physical education. The major in physical education with the dance option is also offered.

A Bachelor of Science degree in physical education may be received through the College of Home Economics or the College of Sciences and Humanities. For undergraduate curricula in physical education for women, see Home Economics, Curricula. Group requirements for a Bachelor of Science degree through the College of Sciences and Humanities are listed under College of Sciences and Humanities, Curriculum.

Curricula in physical education for women prepare students to teach physical education and/or dance. Students may work toward kindergarten through twelfth grade certification or toward secondary certification in either of the above areas. To be accepted in the teacher education program, students must be approved by the departmental committee on selection and the College of Education Committee on Academic Standards. For the teacher education program, including certification requirements, see College of Education.

Although the main purpose of the professional programs in physical education and dance is to prepare teachers, an undergraduate degree in physical education provides the background for work in related areas such as recreation.

In addition to the professional curricula, the department offers a wide selection of beginning, intermediate, and advanced courses in the areas of aquatics, dance, and sports. Students fulfill their physical education requirements by choosing from among any of the activity courses listed. These courses may also be taken as electives after the physical education requirement has been fulfilled. A medical examination is required and evaluated by the medical staff of the Student Health Service. Adapted physical education is provided, according to individual needs, for students who cannot participate in a regular program of activities.

COURSES PRIMARILY FOR UNDERGRADUATE STUDENTS

Beginning Courses

Aquatics

101. SWIMMING I.
    (0-3) Cr. 1. F.W.S.SS.
    Basic course for nonswimmers. Adjustment for deep water swimming.

Dance

117. FOLK DANCE.
    (P.E.M. 117) (0-2) Cr. 1. F.W.S.

118. SQUARE DANCE.
    (P.E.M. 118) (0-2) Cr. 1. F.W.S.

Team Sports

126. BEGINNING VOLLEYBALL.
    (0-2) Cr. 1. F.W.S.

127. BASKETBALL.
    (0-3) Cr. 1. W.
    Prerequisite: Previous experience in basketball.

Individual Sports and Activities

130. BEGINNING TENNIS.
    (0-3) Cr. 1. F.S.SS.

133. BEGINNING BADMINTON.
    (0-3) Cr. 1. W.

135. BEGINNING GYMNASTICS.
    (0-3) Cr. 1. F.W.

136. BEGINNING ARCHERY.
    (0-3) Cr. 1. F.W.S.SS.

138. BEGINNING BOWLING.
    (0-2) Cr. 1. F.W.S.

140. BEGINNING GOLF.
    (0-3) Cr. 1. F.S.SS.
Intermediate and Advanced Courses

Aquatics

201. SWIMMING III.
(0-2) Cr. 1. F.W.S.S.
Prerequisite: 101 or equivalent skill.
Perfection of basic strokes. Introduction to breast and trudgen strokes.

202. SWIMMING IV.
(0-2) Cr. 1. F.W.S.S.
Prerequisite: 201 or equivalent skill.
Perfection of all strokes. Diving skill necessary for springboard diving.

203. LIFE SAVING.
(0-2) Cr. 1. F.W.S.
Prerequisite: Minimum age 16. Ability to swim 220 yards of front crawl, trudgen crawl, or trudgen plus side and breast strokes. Ability to do surface dive, swim underwater, float, and tread water.

204. WATER SAFETY INSTRUCTOR.
(0-4) Cr. 1. F.W.S.
Prerequisite: Minimum age 17. Current Senior Life Saving Certificate. Advanced swimming certificate or equivalent skill.

Dance

220. MODERN DANCE COMPOSITION.
(0-3) Cr. 1. F.W.S.
Prerequisite: 120 or at least two years of high school modern dance or six years of ballet. Theory and practice of creative skills involved in solo and group composition.

222. TECHNIQUES OF MODERN DANCE.
(0-3) Cr. 1. F.W.S.
Prerequisite: 120 or at least two years of high school modern dance or six years of ballet. Instruction and practice in intermediate and advanced modern dance techniques.

Individual Sports and Activities

230. INTERMEDIATE TENNIS.
(0-3) Cr. 1. F.S.
Prerequisite: 130.

231. ADVANCED TENNIS.
(0-3) Cr. 1. F.S.
Prerequisite: 230.
Instruction and practice in the advanced skills of tennis. Emphasis on the use of these skills and strategy employed in effective singles and doubles play.

233. INTERMEDIATE BADMINTON.
(0-3) Cr. 1. W.S.
Prerequisite: 133.

235. INTERMEDIATE GYMNASTICS.
(0-3) Cr. 1. W.S.
Prerequisite: 135.
Instruction and practice of more advanced skills in tumbling and apparatus.

205. SYNCHRONIZED SWIMMING I.
(0-2) Cr. 1. F.W.S.
Prerequisite: Advanced Swimmer as determined by American Red Cross standards. Iowa State University course, and/or preliminary testing. Basic techniques in synchronized swimming, figures, stroking, choreography, and accompaniment.

206. SYNCHRONIZED SWIMMING II.
(0-3) Cr. 1. F.W.
Prerequisite: 205. One year high school synchronized swimming or permission of instructor. Intermediate techniques in synchronized swimming with emphasis on composition.

207. SPRINGBOARD DIVING.
(0-3) Cr. 1. W.S.
Prerequisite: 201 or equivalent. Spring diving from the side of the pool. Forward, back, reverse, and inward dives from the one-meter diving board.

223. ADVANCED MODERN DANCE.
(0-3) Cr. 1. F.S.
Prerequisite: 220, 222.
Instruction and practice of advanced modern dance technique, composition and improvisation.

224. CONCERT MODERN DANCE.
(0-3) Cr. 1. W.
Prerequisite: Open to Orchesis members or by audition only. Choreography, rehearsal, and performance in a modern dance concert.

238. INTERMEDIATE BOWLING.
(0-2) Cr. 1. F.W.S.
Prerequisite: 138.
Instruction and practice in the more advanced skills and techniques. Organization and administration of competition in bowling.

240. INTERMEDIATE GOLF.
(0-3) Cr. 1. F.S.
Prerequisite: 140.

246. INTERMEDIATE FENCING.
(0-3) Cr. 1. W.S.
Prerequisite: 146.
Instruction and practice in the more advanced skills and techniques.

Upon completion of the physical education requirement, any course not already used for credit or any intermediate and advanced course may be elected from the above activity courses.
Elective Courses Open to all Students

200. PHYSICAL ASPECTS OF MUSCULAR ACTIVITY.
(1-2) Cr. 2. F.W.S.
Effects of exercise on the body. Principles involved in the selection and performance of physical activities to meet physical needs. Laboratory. Not open to physical education majors.

356. CAMPING AND OUTDOOR EDUCATION.
(3-0) Cr. 3. S.
Prerequisite: Three credits required physical education. Introduction to camping, objectives, organized camp programs, methods of leadership, and knowledge of camp craft skills, culminating in a cookout and a weekend campout.

379. METHODS OF TEACHING AQUATICS.
(2-1) Cr. 2. S.
Prerequisite: Current Water Safety Instructor’s Certificate. Theory and techniques involved in the teaching of aquatics including instructional, recreational, performing, and competitive programs. Open to prospective swimming specialists in school, camp, or recreational swimming programs.

380. HISTORY AND PHILOSOPHY OF DANCE.
(3-0) Cr. 3. Alt. S, offered 1972.

Professional Program Courses

150, 151, 152. FUNDAMENTALS OF PHYSICAL EDUCATION ACTIVITIES.
(0-3) Cr. 1 each. F.W.S.

165. FUNDAMENTALS OF MODERN DANCE.
(0-3) Cr. 1. F.W.S.
Instruction and practice in the fundamental techniques of modern dance. Emphasis on developing creative skills and basic concepts involved in dance composition.

190. INTRODUCTION TO PHYSICAL EDUCATION.
(3-0) Cr. 3. F.W.S.
Nature and scope of physical education as a profession. The place of physical education in the school with emphasis on need and objectives.

250, 251, 252. FUNDAMENTALS OF PHYSICAL EDUCATION ACTIVITIES.
(0-3) Cr. 1 each. F.W.S.
Skills, strategy, rules of selected activities. Emphasis placed on individual performance. 250: Field Sports. 251: Gymnastics. 252: Softball, Track, Field.

259. PHYSICAL EDUCATION FOR THE ELEMENTARY SCHOOL CHILD.
(2-0) Cr. 2. F.W.
Philosophy, objectives, and scope of physical education in the elementary school. Open to physical education majors only.

280. CREATIVE RHYTHMIC ACTIVITIES FOR ELEMENTARY SCHOOL CHILDREN.
(1-2) Cr. 2. W.
Prerequisite: 259.
Methods of teaching creative rhythmic activities in the elementary grades. Emphasis on the exploration of movement, elements of rhythm, and utilization of the problem-solving approach to teaching. Open to physical education majors in K-12 certification program.

281. GAMES AND ACTIVITIES FOR ELEMENTARY SCHOOL CHILDREN.
(1-2) Cr. 2. S.
Prerequisite: 260.
Methods of teaching games, self-testing activities and gymnastics in the elementary school. Open to physical education majors in K-12 certification program.

270. 271. OFFICIATING.
(1-3) Cr. 2 each. F.W.
Prerequisite: 150, 151, 152.
Techniques and practice in officiating physical education activities. 270: Volleyball. 271: Basketball.

275. PROGRAM DEVELOPMENT IN PHYSICAL EDUCATION.
(3-0) Cr. 3. F.W.S.
Prerequisite: 190.
Principles of developing, planning, and conducting programs of secondary school physical education.

370. PRINCIPLES OF MOTOR PERFORMANCE.
(3-2) Cr. 4. F.
Prerequisite: 275, Zool. 359.
Analysis of motor performance. Principles of motor learning applied to physical education activities.

375. METHODS OF TEACHING TEAM SPORTS.
(0-5) Cr. 2. F.
Prerequisite: 151, 250, 252, 275, Educ. 204.
Methods and techniques of teaching team sports.

376. METHODS OF TEACHING GYMNASTICS AND MODERN DANCE.
(0-5) Cr. 2. W.
Prerequisite: 165, 251, 275, Educ. 204.
Methods and techniques of teaching gymnastics and beginning modern dance.

377. METHODS OF TEACHING INDIVIDUAL SPORTS.
(0-5) Cr. 2. S.
Prerequisite: 150, 152, 275, Educ. 204.
Methods and techniques of teaching individual sports.

Study of the history of dance from early to modern times with emphasis on the theories and philosophies of contemporary modern dance, dancers, and dance educators.

382. ADVANCED STUDIES IN DANCE.
Cr. 1 to 3 in any one quarter with a maximum of 9 credits. F.W.S.
Prerequisites: Permission of Instructor. 382C requires advanced proficiency in performing ability.
A. Production.
B. Choreography.
C. Performance.
D. Related Arts.
Designed to meet special interests and talents of students and include both group and independent study in various aspects of dance as a performing art.

455. PHYSICAL EDUCATION FOR EXCEPTIONAL CHILDREN.
(2-1) Cr. 3. S.
Prerequisite: Psych. 230.
Objectives and scope of physical education for exceptional children, excluding the gifted. Emphasis on adaptation of activities, methods and program planning. Opportunity for observation. Two all-day field trips.
458 Courses and Programs

385. **TECHNIQUES AND METHODS IN SOCIAL, FOLK, AND SQUARE DANCE.**
    (1-2) Cr. 2. F.S.
    Prerequisite: 118, 165.
    Theory and practice of skills involved in executing and teaching social, folk, and square dance. An analytical study of the rhythmic structure inherent in these dance activities.

386. **METHODS OF TEACHING MODERN DANCE: TECHNIQUE AND COMPOSITION.**
    Prerequisite: 165, 376 or permission of instructor. Creative teaching of dance with emphasis on choreographic process.

389. **PROFESSIONAL RELATIONS.**
    (1-0) Cr. R.; W.
    Prerequisite: 375.
    Personal, professional and public relations in education.

417. **SUPERVISED TEACHING IN PHYSICAL EDUCATION IN THE SECONDARY SCHOOLS.**
    Cr. 4 to 12. F.S.
    Prerequisite: 370, Educ. 305.
    Supervised teaching in the secondary schools.

418. **SUPERVISED TEACHING IN PHYSICAL EDUCATION IN THE ELEMENTARY SCHOOL.**
    Cr. 2 to 5. F.S.
    Prerequisite: 261, 370, Educ. 305.
    Supervised teaching in the elementary schools.

420. **ORGANIZATION OF PHYSICAL EDUCATION PROGRAMS.**
    (3-0) Cr. 3. F.W.
    Prerequisite: 275.
    Principles and procedures essential to the organization of a physical education program.

440. **HISTORY AND PHILOSOPHY OF PHYSICAL EDUCATION.**
    (3-0) Cr. 3. S.
    Prerequisite: 190.
    Development of physical education from Greek to modern times and the relationship of prevailing philosophies to physical education.

452. **EVALUATION IN PHYSICAL EDUCATION.**
    (3-3) Cr. 4. F.S.
    Prerequisite: Senior standing.
    Survey and evaluation of tests and measurement procedures used in the field of physical education.

470. **PHYSICAL EDUCATION IN THE ELEMENTARY SCHOOL.**
    (2-3) Cr. 3. F.W.S.
    Prerequisite: C.D. 337.
    Philosophy, objectives, and program of physical education in the elementary school. Methods of teaching basic movement, rhythmic activities, games, and self-testing activities. Open to elementary education majors.

480. **SCIENTIFIC BASES OF PHYSICAL EDUCATION.**
    (3-3) Cr. 4. W.
    Prerequisite: 370, Zool. 155.
    Exercise physiology. Adapted physical education.

490. **SPECIAL PROBLEMS.**
    Cr. 1 to 3 in any one quarter.
    Prerequisite: Junior or senior standing.
    Independent study of problems or areas of interest in physical education and related areas.
    A. Physical Education.
    B. Health.
    C. Recreation.
    D. Dance.
    H. Honors.

495. **SEMINAR IN PHYSICAL EDUCATION.**
    (2-0) Cr. 2. S.
    Prerequisite: Senior standing.
PHYSICS

Daniel J. Zaffarano, Ph.D., Chairman of Department


Undergraduate Study

For the undergraduate curriculum in sciences and humanities, major in physics, leading to the degree Bachelor of Science, see Sciences and Humanities, Curriculum.

Physicists seek to understand and apply the fundamental laws describing the physical universe. Graduates in physics qualify in many fields: as teachers of physics, as research physicists, and as technical personnel and administrators in federal, academic, and industrial laboratories. Although many opportunities exist for men and women who terminate their studies with the bachelor's degree, students who meet the necessary scholastic standards usually continue their studies in a graduate college, where they have ample opportunities to explore and contribute to the most recent developments in the subject.

The standard program in physics usually includes the following courses: 221, 222, 223, 231, 232, 233, 234, 235, 236, 304, 310, 311, 354, 355, 394, 422, 423, 494, 495, 499. This program provides sound preparation for students planning to begin work in research or development laboratories, or to continue their studies in graduate school.

Students planning to enter secondary school teaching will usually complete the following courses: 221, 222, 223, 301, 302, 303, 311, 344, 345, 346, 354, 355, 399, 499.

Outstanding students may find it desirable to follow a program which includes accelerated course work during the junior and senior years. Students in the accelerated program will usually complete the following courses: 221, 222, 223, 231, 232, 233, 234, 235, 236, 304, 310, 311, 361, 362, 363, 394, 411, 481, 482, 483, 489, 494, 495, 496, 499.

As supporting work, undergraduate majors find the following courses desirable: Math. 109, 110, 111, 112, 213, 307, 321, 322, 409, 410, 411; Chem. 141, 142, or 147, 148. Work equivalent to Math. 109 should be completed in high school if possible so that the entering student can begin with Math. 110.

These lists of courses are not to be regarded as statements of fixed requirements or as complete outlines of the work necessary for the major. They are given here for the use of students who wish to estimate the amount of basic study which may be needed. Each student's actual degree program is planned individually with the guidance of an adviser assigned from the physics staff.
Graduate Study

The department offers work for the degrees Master of Science and Doctor of Philosophy with major in physics. Within this major the student may specialize in nuclear physics, solid state physics, high energy physics, or astrophysics at the Ph.D. level. Facilities of the department and of the Institute for Atomic Research, which are closely associated, permit theoretical and experimental investigations in these fields. Minor work is offered to students taking major work in other departments.

Students with bachelor's degrees in physics from other institutions ordinarily will qualify for graduate work here provided they have done satisfactory work in courses similar to those suggested for undergraduate physics majors at this university. In some cases, additional training at the intermediate level may be required.

The Department of Physics requires all graduate students majoring in physics to teach as part of their training for an advanced degree.

Requirements for the degree of Master of Science in physics are as follows: at least 45 credits of acceptable graduate work must be completed, not less than 33 of which must be in physics, and not less than nine from other departments. At least 17 of the credits in physics must be in courses at the 500 or 600 level, exclusive of 595 and 699. Students choosing a degree with thesis may take up to 12 credits of 699, but no credits of 595 are to be applied toward the degree. Students choosing a degree without thesis should take one credit per quarter of 595 (Tutorial Physics), but may not apply research credits in 699 toward the degree. There is no foreign language requirement.

Open to graduate students for minor credit: 304, 310, 311, 344, 345, 346, 354, 355, 394, 411, 421, 422, 423, 447, 448, 449, 490, 494, 495, 496.

COURSES PRIMARILY FOR UNDERGRADUATE STUDENTS

*101. FOUNDATIONS AND FRONTIERS OF PHYSICS.
(4-0) Cr. 4. F.W.S.
An essentially nonmathematical survey of the principal areas of physics, both classical and modern, emphasizing the scope, methods, and goals of physics, and its relation to other fields of human activity.

*106. ELEMENTARY PHYSICS.
(4-2) Cr. 4. F.W.S.S.
Primarily for home economics students. Topics in mechanics, heat, electricity, and light.

111, 112, 113. GENERAL PHYSICS.
(2-4) Cr. 4 each. 111: F.W; 112: W.S; 113: F.S.
Prerequisite: One-and-one-half units of high school algebra, one unit of geometry, and one-half unit of trigonometry.

General background in physical concepts and principles for students who do not plan advanced study in physics or engineering. 111: Mechanics, heat. 112: Electricity and magnetism, wave motion. 113: Topics from relativity, quantum theory, nuclear and solid state physics.

151, 152, 153. INTRODUCTION TO ASTRONOMY.
(2-4) Cr. 2 each. Yr.
Prerequisite: One-and-one-half units of high school algebra, one unit of geometry, and one-half unit of trigonometry.

For students who do not plan advanced study in physics or astronomy. 151: Coordinate systems, planetary motion, astronomical instruments, eclipses, moon and satellites. 152: The solar system. 153: Stars, clusters, galaxies and nebulas.

221, 222, 223. INTRODUCTION TO CLASSICAL PHYSICS.
(6-0) Cr. 5 each. F.W.S.SS.
Prerequisite: 221: Credit or classification in Math. 110; 222, 223: credit or classification in Math. 111; 223: 222.

For engineering and science majors. 221: Elementary mechanics, emphasizing basic conservation laws. 222: Thermal physics; static electric and magnetic fields, simple DC circuits. 223: Time-dependent electric magnetic fields, waves, optics.

231, 232, 233. INTRODUCTION TO MODERN PHYSICS.
(3-0) Cr. 3 each. Yr.
Prerequisite: 223: credit or classification in Math. 213.


234, 235, 236. EXPERIMENTAL PHYSICS.
(0-3) Cr. 1 each. Yr.
Prerequisite: 223: credit or classification in Math. 213 and Com.S. 201.


301, 302, 303. MODERN PHYSICS.
(3-0) Cr. 3 each. Yr.
Prerequisite: 223: credit or classification in Math. 213.

Primarily for undergraduate students in engineering. Special theory of relativity, quantum effects, basic concepts of quantum mechanics, atomic spectra, X-rays, solid state physics and nuclear physics.

*Both 101 and 106 cannot be used for graduation credit.
304. THERMODYNAMICS.
(3-0) Cr. 3. W.
Prerequisite: 223, Math. 213.
Concepts of temperature, entropy, and other characteristic thermodynamic functions; laws of thermodynamics and applications to macroscopic properties of matter.

310. UNDERGRADUATE ELECTRONICS LABORATORY.
(0-6) Cr. 3. F.
Prerequisite: Credit or classification in 394.
Basic properties of electronic components, amplifiers and pulse circuits, feedback.

311. UNDERGRADUATE LABORATORY.
(0-6) Cr. 3 each time taken. W.S.
Prerequisite: 223, Math. 213.
Experiments in classical and modern physics. Emphasis upon planning of experimental procedures.

344, 345, 346. INTRODUCTORY ASTROPHYSICS.
(3-0) Cr. 3 each. Yr.
Prerequisite: 223.

354, 355. INTERMEDIATE MECHANICS.
(3-0) Cr. 3 each. 364: W; 355: S.
Prerequisite: 223, Math. 213.
Newtonian mechanics; dynamics of particles, systems of particles, and rigid bodies. Lagrange’s equations.

361, 362. CLASSICAL MECHANICS.
(3-0) Cr. 3 each. 361: F; 362: W.
Prerequisite: 223, Math. 213.
For physics majors in the accelerated program only. 361: Newtonian mechanics. 362: Lagrangian and Hamiltonian mechanics.

363. INTRODUCTORY QUANTUM MECHANICS.
(3-0) Cr. 3. S.
Prerequisite: 362, Math. 322.
The concepts and elementary applications of quantum mechanics.

371, 372, 373. IDEAS OF PHYSICS.
(3-0) Cr. 3 each. Yr.
Prerequisite: One-and-one-half units of high school algebra, one unit of geometry, and one-half unit of trigonometry.
A presentation primarily to liberal arts students of the basic objectives and methods of physics. 371: Concepts of classical physics—force, momentum, energy, electric and magnetic fields, wave motion, kinetic theory. 372: The evolution in physics from 1900 to 1930—relativity, quantum theory and atomic structure, nuclear physics. 373: Current physics—nucler, fundamental particles, solid state, low temperature.

394. ELECTRONIC CIRCUITS.
(3-0) Cr. 3. F.
Prerequisite: 223, Math. 213.

399. SEMINAR ON SECONDARY SCHOOL PHYSICS.
(2-0) Cr. 1. F.W.S.
Prerequisite: Permission of instructor.
Review of materials and curricula for secondary school physics presented and discussed by members of the class. Required for approval to teach physics in secondary schools.

411. SENIOR RESEARCH LABORATORY.
(0-6) Cr. 3 each time taken.
Prerequisite: Permission of instructor. Projects in experimental or theoretical physics directed on a tutorial basis. Projects selected from fields of current research interest in physics. Emphasis on preparation of students for independent research.
COURSES PRIMARILY FOR GRADUATE STUDENTS, major or minor, open to qualified undergraduates

501, 502. STELLAR INTERIORS.
Prerequisite: 304, and 423 or 483.

504, 505. STELLAR ATMOSPHERES.
Prerequisite: 304, and 423 or 483.
504: Radiative transfer. Model stellar atmospheres. 505: Spectral line formation and broadening mechanism. Curve of growth, abundances, departures from local thermodynamic equilibrium.

507. INTERSTELLAR MATTER.
(3-0) Cr. 3. Alt. S, offered 1972.
Prerequisite: 304, and 423 or 483.

510. OBSERVATIONAL ASTROPHYSICS.
(1-4) Cr. 3. F.S.
Prerequisite: Permission of instructor.
Techniques of astrophysical data acquisition, reduction, and analysis, using photoelectric, spectrographic, and photographic equipment on a telescope.

511, 512, 513. SOLID STATE PHYSICS.
(3-0) Cr. 3 each. Yr.
Prerequisite: Credit or classification in 591, 592, 593 respectively.

517, 518, 519. SOLID STATE PHYSICS.
(3-0) Cr. 3 each. Yr.
Prerequisite: 303 or 423.
Primarily for students not majoring in physics. Topics are similar to 511, 512, 513, but with more emphasis on applications.

524, 525, 526. NUCLEAR PHYSICS.
(3-0) Cr. 3 each. Yr.
Prerequisite: 425 or 483.
Theory of nuclear reactions and alpha, beta, and gamma radioactivity; nuclei; nuclear models. Interaction of charged particles with matter.

531, 532. THERMODYNAMICS, STATISTICAL MECHANICS AND KINETIC THEORY.
(3-0) Cr. 3 each. 531: W; 532: S.

Prerequisite: 495.
Dipole radiation, Fraunhofer diffraction, Kirchhoff integral, Fresnel diffraction, absorption, scattering, and polarization, Zeeman effect, stimulated emission.

534. EXPERIMENTAL TECHNIQUES IN HIGH ENERGY PHYSICS.
(3-0) Cr. 3. SS.
Prerequisite: Permission of instructor. Bubble chamber techniques, design and use of beam transport system, characteristics of present and planned accelerators, spark chamber, and counter techniques.

537, 538, 539. HIGH ENERGY PHYSICS.
(3-0) Cr. 3 each. Yr.
Prerequisite: Credit or classification in 591, 592, 593 respectively.
Special theory of relativity, reaction kinematics, basic properties of elementary particles and reactions, SU(3) and other classification schemes.

564. ADVANCED CLASSICAL MECHANICS.
(3-0) Cr. 3. F.
Prerequisite: 355 or 362; Math. 410.
Advanced methods and problems in dynamics. Lagrange and canonical equations, normal coordinates, rigid body mechanics, canonical transformation, Hamilton-Jacobi equations.

571, 572, 573. ADVANCED ELECTRICITY AND MAGNETISM.
(3-0) Cr. 3 each. Yr.
Prerequisite: Math. 322, 411.

591, 592, 593. QUANTUM PHYSICS.
(3-0) Cr. 3 each. Yr.
Prerequisite: 355 and 423, or 483.
Schroedinger theory, representations, approximation methods, time-dependent problems, elementary scattering theory.

595. TUTORIAL PHYSICS.
Cr. var.
Prerequisite: Permission of instructor.
COURSES FOR GRADUATE STUDENTS, major or minor

611, 612, 613. QUANTUM THEORY OF SOLIDS. (3-0) Cr. 3 each Yr.
Prerequisite: 593.
611. X-ray and neutron diffraction; phonon dispersion relations; one-electron theory and band-structure calculations; exchange and correlation.
612. Optical properties; transport properties; conductivity; magnetic phenomena; the Fermi surface and its determination; cyclotron resonance, de Haas-van Alphen effect, ultrasonic attenuation, magnetoresistance. 613: Crystal field theory; magnetic resonance; cooperative phenomena; magnetism, superconductivity.

624, 625, 626. NUCLEAR THEORY. (3-0) Cr. 3 each Yr.
Prerequisite: 593.
624: Nuclear models and nuclear matter. 625: Beta decay and nuclear spectroscopy. 626: Nuclear reactions.

637, 638, 639. FUNDAMENTAL PARTICLE PHYSICS. (3-0) Cr. 3 each Yr.
Prerequisite: 593.

650. ADVANCED SEMINAR. (1-0) Cr. 1 each time taken. F.W.S.
A. Nuclear Physics.

660. ADVANCED TOPICS IN PHYSICS. Cr. 1 to 3 each time taken. F.W.S.
Courses on advanced topics and recent developments.
A. Nuclear Physics.
B. Solid State Physics.
C. Astrophysics.
D. High Energy Physics.

674, 675, 676. APPLICATION OF GROUP THEORY TO PHYSICS. (3-0) Cr. 3 each Alt. Yrs, offered 1972-1973.
Prerequisite: 593.
674: Theory of groups and group representations. Finite groups, with applications mainly to solid state physics and molecular theory. 675: Theory of continuous groups, with emphasis on the three-dimensional rotation group. The symmetric groups. Applications mainly to systems of many particles. 676: The symmetry properties of space-time. Unitary groups. Applications mainly to particle physics and to nuclear and atomic physics.

681, 682, 683. QUANTUM MECHANICS. (3-0) Cr. 3 each Yr.
Prerequisite: 593.
Angular momentum theory, second quantization, relativistic wave equations, symmetry operators, many-particle theory, propagators, S-matrix.

699. RESEARCH.

PLANT PATHOLOGY

For description of courses, see Botany and Plant Pathology.

POLITICAL SCIENCE

Ross B. Talbot, Ph.D., Chairman of Department

Professors: Donald E. Boles, Ph.D.; Herbert C. Cook, Ph.D.; Don F. Hadwiger, Ph.D.; W. Robert Parks, Ph.D.; Barbara J. Teters, Ph.D.

Associate Professors: Victor A. Olorunsola, Ph.D.; Rolf H.W. Theen, Ph.D.; Robert I. Wessel, Ph.D.; Charles W. Wiggins, Ph.D.

Assistant Professors: James L. Hutter, Ph.D.; Alston J. Shakeshaft, M.S.; John M. Whitmer, Jr., M.A.; Frank L. Wilson, Ph.D.


Undergraduate Study

For the undergraduate curriculum in sciences and humanities, major in political science, leading to the degree of Bachelor of Arts, see Sciences and Humanities, Curriculum.

The study of political science is designed to enable the student to become familiar with theories of public values, patterns of political behavior, and the political institutions and processes of various political systems—national, regional, and international. A political science major should complete a broad liberal arts program and maximize his opportunities for study in related (social science) disciplines, as well as in the various areas of the humanities.
Students majoring in political science may substitute a second major in international studies for the minor requirement in the College of Sciences and Humanities. See International Studies.

A prelaw undergraduate program may be pursued through a major in political science. For a more complete statement, see Preprofessional Study.

Graduate Study

The department offers work for the degree Master of Arts with major in political science. The program is designed to enable its graduates to engage in governmental research, enter the public service or private industry, pursue further graduate study, or teach.

Prerequisite to major graduate work in the department is normally the completion of at least 21 credits in political science.

Each student entering the Master of Arts program in political science is expected to have completed one year of a foreign language (equivalent to 12 quarter credits) and a course in basic statistics (equivalent to Stat. 101). If he has not done so, the deficiency will have to be remedied by passing equivalent courses, for which no graduate credit will be received.

In addition, each student must complete one of the following requirements.

1) Language—Two years of undergraduate instruction (including the one year of foreign language provided above) in a single language, with grades averaging 2.7 (on a 4.0 scale); or, a passing grade in the Educational Testing Service examination.

2) Statistics—Successful completion of Stat. 401. Stat. 402 is recommended also, but not required. It is permissible to substitute Stat. 401 and 402 for Stat. 101 and 401, although to do so a student should audit 101 first.

These requirements are only the basic minimum. The student's program of study committee will decide if additional work, in either language or statistics, is necessary.

The department also offers a Master of Arts program, with no language requirement and a choice of a thesis or an internship requirement, to those students who wish to prepare for, or are employed in, government service.


COURSES PRIMARILY FOR UNDERGRADUATE STUDENTS

215. AMERICAN GOVERNMENT.

(3-0) Cr. 3. F.W.S.
Fundamentals of democracy; nature of federalism; fundamentals of the presidential, congressional, and judicial processes; the role of public opinion, interest groups, and political parties in the governmental process.

216. POLICIES OF AMERICAN GOVERNMENT.

(3-0) Cr. 3. F.W.S.
Prerequisite: 215.
Policies and problems of national government; national security, foreign policy, governmental finance; regulation of business, labor, and agriculture; science, education, and welfare activities.

230. INTRODUCTION TO POLITICAL PHILOSOPHY.

(3-0) Cr. 3. F.S.
Prerequisite: Sophomore classification.
Basic issues in past and contemporary political systems, such as freedom, power, justice, security, general welfare, law, and property.

241. INTRODUCTION TO COMPARATIVE POLITICS.

(3-0) Cr. 3. F.W.S.
Basic concepts and major theories; application to selected political systems, including non-western and communist political systems.

251. INTRODUCTION TO INTERNATIONAL POLITICS.

(3-0) Cr. 3. F.W. Miller.
Traditional concepts of international relations; their alteration by nuclear weapons and the Cold War between the U.S.A. and the U.S.S.R.

310. STATE AND LOCAL GOVERNMENT.

(3-0) Cr. 3. F.W.
Prerequisite: Three credits in political science. Wiggins.
Organization and functions; state regulations and operation; special problems including reorganization of state and local government, consolidation of government areas, financial control, state civil service.

311. MUNICIPAL GOVERNMENT AND POLITICS.

(3-0) Cr. 3. F.S.
Prerequisite: Three credits in political science. Fitzpatrick, Whitmer.
Legal position of municipal corporation, forms of organization, administration of municipal services, problems solved in municipal government, urban political process, goals for urban America.

320. AMERICAN JUDICIAL PROCESS.

(3-0) Cr. 3. F.
Prerequisite: 215. Shakeshaft.
Structure, process, and personnel of American courts; emphasis on governmental and political consequences of court decisions for public policy.

330. INTRODUCTION TO POLITICAL BEHAVIOR.

(3-0) Cr. 3. F.W.S.
Prerequisite: 215 or 230 or 241. Hutter.
Behavioral approach to political science; empirical political practices, systems theory and
331. INTRODUCTION TO EMPIRICAL POLITICAL RESEARCH.  
(3-0) Cr. 3. W.  
Prerequisite: Three credits in political science. Hutter.  
Major types of political science research methods, including polling and surveys, aggregate data, elections and voting, data analysis, machine storage, and statistical treatments.

340. POLITICS OF DEVELOPING AREAS.  
(3-0) Cr. 3. S.  
Prerequisite: 241 or Econ. 411. Olorunsola.  
Analysis of indices of underdevelopment as they relate to the political process of developed states. Impact of social and technological change on the political systems of developing areas.

360. CONGRESS AND THE STATE LEGISLATURES.  
(3-0) Cr. 3. F.  
Prerequisite: Three credits in American government. Wiggins.  
Theory of representation in democratic government. Organization, procedures, voting patterns, and leadership roles of United States Congress and state legislatures.

410. IOWA GOVERNMENT AND POLITICS.  
(3-0) Cr. 3. S.  
Prerequisite: 215 or 310. Wiggins.  
An analysis of Iowa government and politics, focusing upon major institutions of government, political parties, interest groups, legislature, supreme court, and chief executive. Role of municipalities and counties as local units of Iowa government.

420. CONSTITUTIONAL LAW.  
(3-0) Cr. 3. F.  
Prerequisite: 215, junior classification. Boles.  
Development of the United States Constitution through judicial action; influence of public law and judicial interpretations upon American government and society.

421. CIVIL LIBERTIES.  
(3-0) Cr. 3. W.  
Prerequisite: 215, junior classification. Boles.  
American constitutional and statutory guarantees of civil rights. First Amendment rights of conscience and freedom of speech and press; as well as the rights of defendants. Application of equal protection of the laws to minority groups. Various reform proposals.

422. INTERNATIONAL LAW.  
(3-0) Cr. 3. S.  
Prerequisite: 215 or 261; junior classification. Boles.  
Development of the principles of international law of peace and war; analysis of theories concerning its nature and fundamental concepts; its relation to national law; problems of international legislation and codification.

430. DEVELOPMENT OF POLITICAL THOUGHT: ANCIENT AND MEDIEVAL.  
(3-0) Cr. 3. F.  
Prerequisite: Six credits in political science or in European history. Shakeshaft.  
Major political writings from Plato to Bodin. Primary emphasis on the study of translations of original works. An analysis of the ideas contained therein and of the relationships between the theories and their historical context.

431. DEVELOPMENT OF POLITICAL THOUGHT: 16th-18th CENTURIES.  
(3-0) Cr. 3. W.  
Prerequisite: Six credits in political science or in European history. Shakeshaft.  
Major political philosophers from Bodin to Bentham.

432. DEVELOPMENT OF POLITICAL THOUGHT: 19th-20th CENTURIES.  
(3-0) Cr. 3. S.  
Prerequisite: 430 or 431. Shakeshaft.  
Major political philosophers and schools of thought, beginning with Marx and J. S. Mill.

433. AMERICAN POLITICAL THOUGHT.  
(3-0) Cr. 3. S.  
Prerequisite: Six credits in political science or in American history. Talbot.  
Analysis of major trends in the development of American political ideas, institutions, and theories.

434. POLITICAL SOCIALIZATION.  
(3-0) Cr. 3. S.  
Prerequisite: Six credits in political science, 330 recommended. Fitzpatrick.  
Theories of civic education; political learning throughout life; political attitudes, cognitions, and values of products; agents of political socialization; the socialization process; systemic effects of political socialization.

440. BRITISH AND COMMONWEALTH GOVERNMENTS.  
(3-0) Cr. 3. F.  
Prerequisite: 241. Wilson.  
The British political system and its influence on governments of the Commonwealth countries.

441. GOVERNMENTS OF WESTERN EUROPE.  
(3-0) Cr. 3. W.  
Prerequisite: 241. Wilson.  
Comparative study of governments of France and Germany. Their governmental processes, political parties, electoral systems, and political problems. Comparison with United States.

442A. GOVERNMENTS OF CHINA AND JAPAN.  
(3-0) Cr. 3. W.  
Prerequisite: 241 or 3 credits from D. S1. 207, 208, 209. Teters.  
Political traditions and political cultures, contemporary governmental structures and processes.

442B. GOVERNMENTS OF INDIA, PAKISTAN, AND SOUTHEAST ASIA.  
(3-0) Cr. 3. S.  
Prerequisite: 241. Teters.  
Political traditions and political cultures, contemporary governmental structures and processes.

443A. LATIN AMERICAN GOVERNMENTS.  
(3-0) Cr. 3. W.  
Prerequisite: 241 or 6 credits in Latin American history. Schmidt.  
Political institutions and processes in the Latin American nations.

443B. RECENT LATIN AMERICAN POLITICS.  
(3-0) Cr. 3. F.  
Prerequisite: 241 or 6 credits in Russian history. Theen.  
Analysis of Russian political tradition. Organization and functioning of the Communist Party and its role in development of the Soviet Union. Governmental structure and processes of the Soviet political system.
445. POLITICS OF THE MIDDLE EAST.
(3-0) Cr. 3. Alt. S. offered 1973.
Prerequisite: 241 or 340.
Governments of the Middle East. Special attention to impact of social and technological change on the political process.

446A, 446B. GOVERNMENTS OF AFRICA:
SOUTH OF THE SAHARA.
(3-0) Cr. 3 each. W.S.
Prerequisite: 251 or 3 credits from D.St. 204, 205, 206. Olorunola.
Politics and governments of selected African states and territories south of the Sahara. 446A: West Africa. 446B: East Africa.

451. ASIA IN WORLD AFFAIRS.
(3-0) Cr. 3. S.
Prerequisite: 251 or D.St. 209. Teters.
Analysis of factors shaping objectives and policies of major Asian countries as participants in world politics.

452. COMPARATIVE FOREIGN POLICIES.
(3-0) Cr. 3. W.
Prerequisite: 251. Miller.
Foreign policies of selected nations other than the U.S.A. and U.S.S.R.

453. INTERNATIONAL ORGANIZATIONS.
(3-0) Cr. 3. S.
Prerequisite: 251. Miller.
Role of the United Nations and of regional organizations in the international system.

458. UNITED STATES FOREIGN POLICY.
(3-0) Cr. 3. W.S.
Prerequisite: 215, 251 recommended. Miller.
Elements of U.S. foreign policy, foreign policymaking process, governmental and nongovernmental agencies operating on the formation of foreign policy, trends and issues, national purposes, diplomacy, and impact of the Cold War.

464. AMERICAN POLITICAL PARTIES.
(3-0) Cr. 3. F.
Prerequisite: Six credits in American government. Wiggins.
Systems theory applied to political parties, concepts of group structure, party evolution, party supporters and leaders, voting behavior, party in government.

467. INTEREST GROUPS IN AMERICAN POLITICS.
(3-0) Cr. 3. W.
Prerequisite: Six credits in American government. Hadwiger.
Historical development of political interest groups, major theories of their role groups, internal structure and operations of interest groups, relationships between interest groups and governmental, including the role played by lobbyists in the political process.

468. PUBLIC OPINION AND PUBLIC POLICY.
(3-0) Cr. 3. S.
Prerequisite: Six credits in American government. Hadwiger.
Role of public opinion in American politics, dimensions and agencies of opinion formation, structure and distribution of opinions, opinion sampling of selected policy alternatives.

471. PUBLIC ADMINISTRATION.
(3-0) Cr. 3. F.
Prerequisite: Six credits in American government. Wessel.
Analysis of the operations of the executive branch of government. Problems of organizing that branch to achieve maximum efficiency.

472. GOVERNMENT AND REGULATION.
(3-0) Cr. 3. S.
Prerequisite: Six credits in American government. Wessel.
Structure and politics of regulatory agencies. Interactions of the executive, congress, judiciary, and regulatory agencies.

473. POLITICS OF FOOD AND FIBER POLICIES.
(3-0) Cr. 3. W.
Prerequisite: Six credits in American government. Youngberg.
The U.S. policy process as it relates to selected food and fiber policies: exports-commercial and concessional, imports, health and nutrition, welfare and education, research, price and income.

474. GOVERNMENT AND CONSERVATION POLICIES.
(3-0) Cr. 3. W.
Prerequisite: Six credits in American government. Talbot.
The political process in the area of public and private land, forest, water, and recreation policies. National legislative, executive, and administrative processes as they apply to federal grant-in-aid programs. State policies.

475. SCIENCE AND GOVERNMENT.
(3-0) Cr. 3. W.
Prerequisite: Six credits in American government. Talbot.
The political impact on selected policy development in certain Federal organizations, e.g., NASA, AEC, HEW, Commerce, and NSF.

476. ADMINISTRATIVE LAW.
(3-0) Cr. 3. S.
Prerequisite: 215, junior classification. Boles.
 Constitutional problems of delegation of governmental powers, elements of fair administrative procedures, judicial control over administrative determinations.

490. SPECIAL PROBLEMS.
Cr. 2 to 6 each time taken. F.W.S.
Special studies in the political institutions, processes and policies of American, foreign, and international governments. Also, study in traditional and behavioral political theory. H. Honors.

COURSES PRIMARILY FOR GRADUATE STUDENTS, major or minor, open to qualified undergraduates

510. STATE GOVERNMENT AND POLITICS.
(3-0) Cr. 3. F.
Prerequisite: 310. Wiggins.
A comparative analysis of state political systems. Role of interest groups, political parties, legislatures, courts, and governors in state politics. Examination of possible determinants of public policy outputs at the state level.

511. PUBLIC POLICY AND LOCAL GOVERNMENT.
(3-0) Cr. 3. W.
Prerequisite: 310. Boles.
Analysis of structure, administration, and legal basis of the county, township, and special districts such as school and drainage districts. Evaluation of local governmental functions such as education, welfare, highways, including problems of taxation and finance. Effects of population shifts on future of local governments.
512. URBAN POLITICS.
(3-0) Cr. 3. W.
Prerequisite: 311, Fitzpatrick.
Structure and process of urban political systems, selected problems in urban politics.

520. PUBLIC LAW AND PUBLIC POLICY.
(3-0) Cr. 3. S.
Prerequisite: 320 or 420, Boles.

530. ADVANCED POLITICAL THOUGHT.
(3-0) Cr. 3. S.
Prerequisite: Six credits in courses numbered 430 through 453, Shakeshaft.
Intensive study of one or more of the traditional and contemporary political philosophers.

531A. RESEARCH METHODS IN POLITICAL SCIENCE.
(3-0) Cr. 3. F.
Prerequisite: 331.
Survey research, questionnaire design, sampling, aggregate data collection and analysis, machine storage, and statistical analysis of data.

531B. RESEARCH METHODS IN POLITICAL SCIENCE.
(3-0) Cr. 3. W.
Prerequisite: 331.
Games, simulations, voting studies, legislative data, judicial data, scale construction, and other methods.

532A. BEHAVIORAL POLITICAL THEORY.
(3-0) Cr. 3. W.
Prerequisite: 330, 331, Hutter.
System theory, communications theory, structural-functional analysis, and other theories at the macro, or systemic, level.

532B. BEHAVIORAL POLITICAL THEORY.
(3-0) Cr. 3. S.
Prerequisite: 330, 331, Hutter.
Middle- or micro-level theory of empirical political behavior. Psychological, sociological, economic, and historical association with political behavior.

542. JAPANESE POLITICAL THOUGHT AND INSTITUTIONS.
(3-0) Cr. 3. Alt. S, offered 1972.
Prerequisite: 442A, Teters.

544. RUSSIAN POLITICAL THOUGHT AND INSTITUTIONS.
(3-0) Cr. 3. S.
Prerequisite: 444 or 6 credits in Russian history, Theen.
Selected works in Russian political thought from the Decembrists to the present, especially those of Lenin. Development of Russian political thought since the Revolution and its relation to development of Russian political institutions.

556. SOVIET FOREIGN POLICY.
(3-0) Cr. 3. W.
Prerequisite: 444 or 6 credits in international studies and comparative politics, Theen.
Basic factors determining the formulation and execution of Soviet foreign policy. Analysis of the process and development of Russian foreign policy since 1917, emphasizing the Stalin period of the Cold War.

559. INTERNATIONAL RELATIONS THEORY.
(3-0) Cr. 3. F.
Prerequisite: Six credits in international studies. Miller.
A review, analysis, and application of recent theoretical attempts to order systematically the field of international relations. Special attention devoted to the concepts of power, equilibrium, communications, decision making, and systems analysis.

560. LEGISLATIVE BEHAVIOR.
(3-0) Cr. 3. S.
Prerequisite: Six credits in American government. Wiggins.
Principles, procedures, and problems of the legislative process. Structure and organization of state legislatures and the United States Congress.

561. THE CHIEF EXECUTIVE.
(3-0) Cr. 3. W.
Prerequisite: Nine credits in American government. Hadwiger.
Legal and political forces influencing the U.S. president, governors, and other governmental executives in decision making, developing and administering programs of government, and influencing public opinion, and influencing legislation.

563. CONTEMPORARY ISSUES IN AGRICULTURAL POLICY.
(Econ. 563) See Economics.

571. THE ADMINISTRATIVE PROCESS.
(5-0) Cr. 3. W.
Prerequisite: 471, Wessel.
An analysis of classic and current administrative theory, with applications to the budgetary process.

590. SPECIAL TOPICS.
Cr. 2 to 5 each time taken.
Prerequisite: Fourteen credits in political science, permission of instructor.
A. American Political Institutions.
B. Public Law.
C. Political Theory and Methodology.
D. Comparative Government.
E. International Relations.
F. Policy Process.
G. Public Administration and Public Policy.

COURSES FOR GRADUATE STUDENTS, major or minor

810. GRADUATE SEMINARS.
(3-0) Cr. 3 for each seminar.
Prerequisite: Fifteen credits in graduate courses in political science.
A. American Political Institutions.
B. Public Law.
C. Political Theory and Methodology.
D. Comparative Government.
E. International Relations.
F. Policy Process.
G. Public Administration and Public Policy.

POULTRY SCIENCE

For description of courses, see Animal Science.
PREPROFESSIONAL STUDY AT IOWA STATE UNIVERSITY

Requirements for admission to most professional academic programs can be met by study at Iowa State University. Preprofessional programs vary from one to four years. In some programs requiring three years of preprofessional work, a student may, by careful planning, complete requirements for the bachelor's degree upon transferring to Iowa State 45 quarter credits of professional course work. These programs are described under the heading Combination Preprofessional and Baccalaureate Programs.

Most law schools and schools of human medicine now require for admission either a bachelor's degree or satisfactory completion of three years leading to the bachelor's degree. A few still require only three years of preprofessional work, but students are urged to choose a degree program so that they will not be limited in their choice of professional schools.

Students are encouraged to identify their professional interests early in their college studies. As soon as this choice is made, students will be assigned to advisers who are familiar with requirements of the respective professional schools.

Specific information on these preprofessional programs will be furnished, upon request, by the dean, College of Sciences and Humanities.

Combination Preprofessional and Baccalaureate Programs

Preparation for the Study of Dentistry. The Council on Dental Education of the American Dental Association has prescribed two years of college education as a minimal requirement for admittance to a dental school. Because some dental schools have more extensive preprofessional requirements oriented toward a more liberal education, predentistry students are advised to take three years of preparatory college work, which, with the first year of dental school, may lead to receipt of the bachelor's degree from Iowa State University.

Preparation for the Study of Medical Technology. Medical technologists work usually under the supervision of a physician in hospital laboratories, medical clinics, industrial medical laboratories, pharmaceutical laboratories, and in conjunction with public health agencies. The minimal preprofessional requirement is three years of college study emphasizing communication skills, biology, chemistry, and electives in social sciences, arts, and humanities. Students may receive the bachelor's degree from Iowa State University by completing a program including three years of college work plus a year of professional study at any hospital school of medical technology approved by the American Medical Association.

Preparation for the Study of Physical Therapy. Physical therapists work under the direction of physicians in administering therapeutic agents such as massage and exercise, heat, baths, light, and electricity. Preprofessional education should include three academic years of study leading to strong backgrounds in the natural sciences, social sciences, and humanities. Students may receive the bachelor's degree from Iowa State University by transferring back 45 credits from the first year in a school of physical therapy.

Preparation for the Study of Veterinary Medicine. Although most schools of veterinary medicine require two years of preprofessional college education, more students are choosing three years of college work before beginning their professional programs. This permits them to broaden their education in both the sciences and humanities, and may lead to the baccalaureate from Iowa State University upon completion of the first year of study in a school of veterinary medicine. For additional information see Veterinary Medicine, Admission Requirements.

Four-Year Preprofessional Programs

Preparation for the Study of Human Medicine. Most medical schools recommend a preprofessional background composed of a good foundation in the natural sciences (mathematics, chemistry, biology, physics), highly developed communication skills, and a rich background in the social sciences, humanities, and arts. To obtain this background, students should elect four years of preprofessional study leading to the bachelor's degree. A less desirable choice includes three years of preprofessional study and one year of professional education at a medical school (including approved schools of osteopathy), at the end of which the bachelor's degree will be granted by Iowa State University.
Preparation for the Study of Law. Most law schools now require applicants to present a bachelor's degree from a college or university prior to commencing the study of law. In cases where students can be admitted to an accredited law school without having obtained the bachelor's degree, Iowa State, in certain curricula, will grant this degree following three years of study here and completion of suitable credits (usually obtainable in one year) at a law college. Programs of three-year prelaw education (with the bachelor's degree deferred) at Iowa State University should be planned not later than the sophomore year, and must be approved by the student's major department and by the dean of the college in which the student is enrolled.

Other Preprofessional Programs

Preparation for the Study of Nursing. Depending upon the extent of professional nursing education desired by students, Iowa State University offers one or two years of preprofessional study in the sciences and humanities. After completion of the preparatory program, students transfer to some other institution offering professional education in nursing.

Preparation for the Study of Marine Biology, Oceanography (Chemical, Geological, Physical), and Pharmacology. College preparatory work for each of these areas consists of a program leading to the bachelor's degree, after which students begin technical programs of study at the graduate level, leading to advanced degrees. Iowa State University offers in preparation for each of these areas a full undergraduate program leading to the bachelor's degree.

PSYCHOLOGY

Don C. Charles, Ph.D., Acting Head of Department


Associate Professors: Lloyd L. Avant, Ph.D.; David C. Edwards, Ph.D.; Ronald H. Peters, Ph.D.; Donald G. Zytowski, Ed.D.


Undergraduate Study

For the undergraduate curriculum in sciences and humanities, major in psychology, leading to the degree Bachelor of Science, see Sciences and Humanities, Curriculum. Psychologists are concerned with behavioral research and teaching in the areas of theoretical, comparative and physiological, psychometric, developmental, educational, differential, social, and personality psychology. Applied psychologists utilize the results of basic research in a variety of ways. Clinical psychologists work with mentally ill persons and those with personality and adjustment problems. Counseling psychologists work most often in schools and colleges with people who have personal and vocational problems to solve. Industrial psychologists work in business, industry, government, and the military to help improve the efficiency and personal satisfaction of workers. Psychologists also work in the public schools with pupil problems, especially those of exceptional (different from the average) children.
An undergraduate major in psychology may be taken as general education, or as preparation for graduate study. Holders of the baccalaureate work in a wide variety of settings. Professional work in psychology requires graduate degrees.

A program of study will be developed in consultation with the major adviser which meets the needs and interests of the student and the department.

The psychology requirement for an Iowa professional teaching certificate will be met by 101, 230, and 333.

Graduate Study

The department offers work for the degrees Master of Science and Doctor of Philosophy with major in psychology, and minor work to students taking major work in other departments. A two-year Master of Science interdisciplinary program is offered in school psychology.

Students desiring a graduate major in psychology must have been graduated from an accredited college in a curriculum substantially equivalent to the undergraduate curriculum in Sciences and Humanities at Iowa State University. Prerequisite to admission is at least 15 credits of basic psychology, which should include a laboratory course and a measurement-statistics course.

There is no foreign language requirement for the advanced degrees offered by this department.

Open to graduate students for minor credit only: 401, 430, 436, 440, 441, 451, 460, 490, 491, 495.

COURSES PRIMARILY FOR UNDERGRADUATE STUDENTS

10. ACADEMIC LEARNING SKILLS. (2-0) Cr. 0. F.W.S.S.
Efficient methods of studying and reading.

101. GENERAL PSYCHOLOGY. (3-0) Cr. 3. F.W.S.S.
Introduction to fundamental psychological concepts derived from the application of scientific method to the study of behavior. Applications of psychology.

202. SENSATION AND PERCEPTION. (3-0) Cr. 3. F.W.S.S.
Prerequisite: 101.
Appraisal of traditional and contemporary psychophysical models. General characteristics of the senses; conditions and principles of human perception with emphasis on vision.

206. LEARNING AND MOTIVATION. (3-0) Cr. 3. F.W.S.S.
Prerequisite: 101.
Fundamental concepts and principles of learning and motivation. Consideration of data from human and animal experimentation.

230. DEVELOPMENTAL PSYCHOLOGY. (Educ. 230) (3-0) Cr. 3. F.W.S.S.
Prerequisite: 101.
Characteristics development and decline of physical traits, learning and intelligence, social and emotional behavior, personality and adjustment from conception to senescence. Emphasis on childhood and adolescence. 230H: Honors section. Emphasis on original research literature and individual projects. For students in University Honors Program only.

250. CONSUMER PSYCHOLOGY. (3-0) Cr. 3. F.W.
Prerequisite: 101.
Application of psychological principles in marketing to include selling, advertising, packaging, and sales promotion; introduction to consumer surveys and motivation research techniques.

301. RESEARCH DESIGN AND METHODOLOGY. (3-0) Cr. 3. F.W.
Prerequisite: 202, 206, Stat. 101.

Research methodology in psychology. Emphasis on rationale underlying procedures for control and manipulation of experimental variables. Designs appropriate for various research questions and of procedures for data reduction and evaluation.

302. EXPERIMENTAL PSYCHOLOGY LABORATORY. (0-6) Cr. 3. F.W.
Prerequisite: Credit or classification in 301. Laboratory experience in designing and executing research in various areas of experimental psychology. Emphasis on designing experiments, setting up laboratory equipment, collecting and evaluating data, and preparing research reports.

304. ANIMAL BEHAVIOR. (Zool. 304) See Zoology.

305. PHYSIOLOGICAL PSYCHOLOGY. (2-2) Cr. 3. S.

333. EDUCATIONAL PSYCHOLOGY. (Educ. 333) (2-2) Cr. 3. F.W.S.S.
Prerequisite: 230.
Study of human learning, with particular attention to applications in the classroom. Laboratory experience in use of school standardized tests and practice in planning, developing, and analyzing teacher-made tests. 333H: Honors section. Emphasis on original research literature and individual projects. For students in the University Honors program only.

345. INDIVIDUAL DIFFERENCES. (3-0) Cr. 3. F.S.
Prerequisite: 101.
Individual differences in psychological characteristics and behaviors. Factors producing and effecting these differences. Differences among groups; sex, race, class.
360. PSYCHOLOGY OF PERSONALITY.
(3-0) Cr. 3. F.S.
Prerequisite: 101.
Major approaches to the study of personality. Emphasis on development and study of "normal" personality.

380, 381. SOCIAL PSYCHOLOGY.
(3-0) Cr. 3 each. 380: F.W.S.SS; 381: W.S.
Prerequisite: 380: Six credits in psychology; 381: 380.
380: The individual in society. Person perception, social influence, attraction, socialization. Research methods. 381: The individual in small groups. Communication, leadership, cooperation, power, conformity and deviation, bargaining, status, norms, roles.

385. PSYCHOLINGUISTICS.
(3-0) Cr. 3. S.
Prerequisite: Six credits in psychology.
Psychology of language and language processes: theory and findings in speech perception, cognition, memory for linguistic stimuli, and development of linguistic processes.

401. HISTORY AND SYSTEMS IN PSYCHOLOGY.
(3-0) Cr. 3. F.
Prerequisite: Twelve credits in psychology. Philosophical and theoretical antecedents of contemporary psychology.

430. PSYCHOLOGY OF ADOLESCENCE.
(3-0) Cr. 3. F.W.S.SS.
Prerequisite: 230, junior standing.
Developmental characteristics of the adolescent; examination of antecedents of behavior with a goal of better understanding of this age group; implications for education and guidance.

436. PSYCHOLOGY OF EXCEPTIONAL CHILDREN.
(3-0) Cr. 3. F.W.S.SS.
Prerequisite: 230, or C.D. 336 and 337.
Behavioral characteristics, problems, and needs of a wide variety of atypical children, including the gifted.

440. PSYCHOLOGICAL MEASUREMENT I.
(3-0) Cr. 3. F.W.S.SS.
Prerequisite: Six credits in psychology, Stat. 101.
Principles of psychological measurement including sources of test information, quantitative concepts with applications to test construction, factors influencing test performance, uses and misuses of tests in counseling, educational, and industrial settings.

441. PSYCHOLOGICAL SCALING TECHNIQUES.
(3-0) Cr. 3. S.
Prerequisite: 440.
Theory and techniques of psychological scaling, with emphasis on attitude scaling. Unidimensional approaches of Thurstone, Likert, Guttman. Introduction to multidimensional model.
Courses and Programs

515, 518. ADVANCED PHYSIOLOGICAL PSYCHOLOGY.
Prerequisite: Zool. 320 and 465, or V. Anat. 217 and V. Pharm. 264.
515: Neuropsychological correlates of behavior with emphasis on sensory-motor systems. 516: Neuropsychological correlates of behavior with emphasis on motivation and learning.

522. PSYCHOLOGY OF COUNSELING.
(3-0) Cr. 3. F.S.
Prerequisite: 440 and 12 additional credits in psychology.
Counseling procedures and techniques. Theory, research, and evaluation of counseling. Counseling as a profession.

523. VOCATIONAL PSYCHOLOGY.
(2-2) Cr. 3. W.
Prerequisite: Nine credits in psychology.
Theories of vocational behavior, including vocational choice, and their relationship to job satisfaction and job performance. Developmental aspects and occupational classification systems.

530. ADVANCED DEVELOPMENTAL PSYCHOLOGY.
(3-0) Cr. 3. S.SS.
Prerequisite: 220 or C.D. 336, 9 additional credits in psychology.
Critical evaluation of major research in physical, sensory, intellectual, emotional, and social development. Human behavior from conception to senescence. Maturity and old age emphasized.

531. PSYCHOLOGY OF EXCEPTIONAL INTELLIGENCE.
(3-0) Cr. 3. Alt. F, offered 1971.
Prerequisite: 436, 12 additional credits in psychology.
Study of psychological characteristics of the mentally deficient, and the gifted and creative. Theoretical views, current research in learning and cognition, perception, language, motor skills, adjustment; implications for clinical and educational practice.

533. ADVANCED EDUCATIONAL PSYCHOLOGY.
(3-0) Cr. 3. Alt. S, offered 1972.
Prerequisite: 333, 6 additional credits in psychology.
Examination of learning theories as they relate to educational practices. Review and evaluation of research findings involving applications of learning principles to educational practices.

534. RESEARCH METHODS IN EDUCATIONAL PSYCHOLOGY.
(3-0) Cr. 3. Alt. S, offered 1973. SS.
Prerequisite: 333, 6 additional credits in psychology.
Application of psychological principles and methodology to study of educational problems. Consideration of education as a behavioral science. Design and evaluation of psychological research on problems related to education.

535. PSYCHOLOGY OF READING.
(3-0) Cr. 3. Alt. W, offered 1973.
Prerequisite: 250, 333.
Psychology of the reading process, its nature and development including effects of both internal and external factors on performance. Evaluation and diagnosis of reading skills. Remedial and developmental procedures.

540. PSYCHOLOGICAL MEASUREMENT II.
(3-0) Cr. 3. W.
Prerequisite: 440, Stat. 401.
Theoretical and instrumental definition of variables. Theoretical and philosophical approaches to reliability and validity.

541. INDIVIDUAL MENTAL TESTING: ADULTS.
Prerequisite: 440, permission of instructor.
Theory of individual mental testing. Development of commonly used tests at the adult level. Techniques of administering, scoring, and interpreting the results of individually administered mental tests at the adult level. Practicum included.

542. INDIVIDUAL MENTAL TESTING: CHILDREN.
(2-3) Cr. 3. W.SS.
Prerequisite: 440, permission of instructor.
Theory of individual mental testing. Development of commonly used tests for children. Techniques of administering, scoring, and interpreting the results of individually administered tests for children. Practicum included.

545. DIFFERENTIAL PSYCHOLOGY.
(3-0) Cr. 3. S.
Prerequisite: 440.

550. PERFORMANCE MEASUREMENT.
(3-0) Cr. 3. Alt. F, offered 1972.
Prerequisite: 440 or permission of instructor.

551. ORGANIZATIONAL PSYCHOLOGY.
(3-0) Cr. 3. Alt. W, offered 1973.
Prerequisite: 451, 550.
Methods, theory, and practice of industrial-social psychology, with emphasis on behavioral research in industrial settings.

560. PERSONALITY THEORIES.
(3-0) Cr. 3. F.
Prerequisite: 460 or graduate standing.
Major concepts, methods, and problems in study of personality. Analysis of theories of personality, with emphasis on personality development in the normal population.

561. PSYCHOPATHOLOGY AND BEHAVIOR DEVIATIONS.
(3-0) Cr. 3. W.
Prerequisite: 460 or graduate standing.
Application of personality theory to the study of abnormal behavior. Analysis of etiology and dynamics of various psychopathological entities, including psychoneuroses and psychoses.

562. PERSONALITY ASSESSMENT.
(3-0) Cr. 3. S.
Prerequisite: 460 or graduate standing.
Basic concepts underlying personality assessment. Objective and projective methods for measurement of personality.

568. ADVANCED SOCIAL PSYCHOLOGY I.
(3-0) Cr. 3. F.S.
Prerequisite: 380, 9 additional credits in psychology.
Research methods and contemporary theories in social psychology, emphasizing attitude formation and change, perception of other people, attraction, and aggression.

581. ADVANCED SOCIAL PSYCHOLOGY II.
(3-0) Cr. 3. W.
Prerequisite: 380, 9 additional credits in psychology.
Theoretical and empirical study of the effects of group membership on individual behavior.
590. SPECIAL TOPICS.
Cr. var.
Prerequisite: Twelve credits in psychology, permission of instructor.
Guided reading on special topics, or individual research projects. Permission of a faculty member must be obtained prior to registration.
A. History and Systems.
B. Safety.
C. Consumer.

COURSES FOR GRADUATE STUDENTS, major or minor

601, 602, 603. HISTORICAL AND SYSTEMATIC PSYCHOLOGY.
(2-0) Cr. 2 each. Yr.
Prerequisite: 601: Second year graduate standing; 602: 601; 603: 602.
601: Origins of psychology in classical, medieval, and Renaissance thought. Development of psychology as a science in nineteenth and twentieth centuries. Historical roots of contemporary problems. 602: Philosophical and methodological problems of psychology. Traditional and contemporary procedures and strategies in the study of psychology. 603: Traditional and contemporary theoretical approaches to learning, sensation-perception, personality, development, and abnormal psychology.

604. COGNITION.
(3-0) Cr. 3. F.
Prerequisite: 504.
Advanced experimental investigation and theory of cognitive processes including thinking, problem-solving, and conceptual behavior.

605. PSYCHOLOGY OF MOTIVATION.
(2-0) Cr. 2. W.
Prerequisite: 503 or 504.
Major research findings and theoretical concepts in the psychology of motivation.

607. ETHOLOGY.
(Zool. 607) See Zoology.

620. PSYCHOLOGICAL COUNSELING.
(3-0) Cr. 3. F.W.S.
Prerequisite: 522.
Advanced theory and practice in psychological counseling with emphasis on application of counseling and testing techniques. Case studies and role playing.

633. TEACHING OF PSYCHOLOGY.
(3-0) Cr. 3. F.S.
Prerequisite: Enrollment in Ph.D. or terminal M.S. program in psychology, completion of at least one year graduate study, permission of instructor.
Orientation to teaching of psychology at college level: academic issues and problems, instructional and evaluative techniques.

691. PRACTICUM IN PSYCHOLOGY.
Cr. var.
Prerequisite: Permission of instructor.
Supervised practice and experience in the following fields of specialization in applied psychology.
A. Counseling Psychology.
B. Industrial Psychology.
C. School Psychology.
D. Individual Testing.
E. Teaching of Psychology.

692. SEMINAR IN PSYCHOLOGY.
(1 to 3-0) Cr. 1 to 3 each time taken. Offered when demand warrants.
Prerequisite: Graduate standing.
A. Counseling.
B. Educational-Developmental.
C. General-Experimental.
D. Industrial-Organizational.
E. Psychometrics.
F. School Psychology.

699. RESEARCH.

SOCIOLOGY AND ANTHROPOLOGY

George M. Beal, Ph.D., Chairman of Department

Professors: Joe M. Bohlen, Ph.D.; Dwight G. Dean, Ph.D.; Walter A. Lunden, Ph.D.; Ronald C. Powers, Ph.D.; Margaret C. Warning, Ph.D.

Associate Professors: Gordon Bultena, Ph.D.; Harry Cohen, Ph.D.; David M. Gradwohl, Ph.D.; Gerald E. Klonglan, Ph.D.; Charles L. Mulford, Ph.D.; Richard D. Warren, Ph.D.

Assistant Professors: Binod C. Agrawal, Ph.D.; Rita Braitgo, Ph.D.; Brent Bruton, Ph.D.; H.C. Chang, Ph.D.; Willis J. Goudy, Ph.D.; Patricia Keith, Ph.D.; Edward A. Powers, Ph.D.; Robert Richards, Ph.D.; David Rogers, Ph.D.; Robert Schafer, Ph.D.; John Tait, Ph.D.; Lealle Wilcox, Ph.D.; J. Paul Yarbrough, Ph.D.; Benjamin Yep, Ph.D.; Dean R. Yoesting, Ph.D.

Instructors: Allan Bashor, M.S.; Jill Deskin, B.A.; Sylvia Fox, B.A.; Steve Garrigues, M.S.; Joseph Hraba, M.A.; Art Johnson, M.S.; Martin Miller, M.S.; William Ringle, B.S.; David Specht, M.A.

Associates: Ralph Brooks, M.S.; Dorothy Bashor, M.S.; Dave Duncan, M.S.; Gene Lutz, M.S.; Steve Paulson, M.S.; Steve Padgitt, M.S.
Courses and Programs

Undergraduate Study

The department offers work for the degrees Bachelor of Arts and Bachelor of Science with majors in sociology and in anthropology, and work for the degree Bachelor of Science in Public Service and Administration in Agriculture. Programs of study offered in both the College of Agriculture and the College of Sciences and Humanities are outlined in this section. For the undergraduate curriculum in Sciences and Humanities, majors in sociology and anthropology, leading to the degrees of Bachelor of Arts and Bachelor of Science, see Sciences and Humanities, Curriculum. For the undergraduate curriculum in Agriculture, major in Public Service and Administration in Agriculture, leading to the degree Bachelor of Science, see Agriculture, Curriculum in Public Service and Administration in Agriculture.

College of Sciences and Humanities—Sociology

Graduates in sociology qualify as research and applied sociologists in business, industry, government, and social work, and as teachers of sociology.

A program of study which meets the needs and interests of the student will be developed in consultation with the major adviser. Programs leading to the Bachelor of Arts degree will ordinarily provide for greater emphasis upon the arts in Group 8 of the general education requirement than will programs leading to the Bachelor of Science degree. Some of the possible fields of concentration are family sociology, leisure and environmental resources, criminal justice system, industrial sociology, research methods and statistics, community (urban and rural sociology), social change and sociology of development, social welfare, complex organization, human population and ecology, and sociological theory. Programs will include 134, 201, 202, 302, 305, and 310.

Sociology majors may substitute a second major in International Studies for the college minor requirement.

College of Sciences and Humanities—Anthropology

An undergraduate major in anthropology can serve as the nucleus for a general liberal education, or as the prerequisite for graduate training qualifying a person for positions in (1) college and university teaching, (2) research, and (3) administrative and applied positions in government and museums. Fields of anthropology are cultural anthropology (ethnology, social anthropology, archaeology, psychological anthropology, and anthropological linguistics) and physical anthropology (man’s biological evolution, constitution, and modern variations). Anthropology majors usually obtain a Bachelor of Arts degree by fulfilling the general education requirements. Undergraduate students may obtain experience in archaeological and ethnological research. Programs leading to the Bachelor of Science degree must have at least 55 credits in the mathematical, physical, and biological sciences, and must be applied to Groups 2, 3, and 4 of the general education requirement.

Undergraduate students with majors in anthropology usually include the following courses in their programs: 111, 218, 219, 220, 321, 421, and 422. Excellent supporting courses directly related to anthropology will be found in sociology, psychology, zoology, genetics, history, political science, philosophy, earth science, and economics. Undergraduates majoring in anthropology may elect these areas or others as minors. Anthropology majors may substitute a second major in International Studies for the college minor requirement. Undergraduates majoring in sociology and majors outside the department may minor in anthropology.

The principal subdisciplines of anthropology are represented by the following:

3. Psychological Anthropology: 422.
5. Physical Anthropology: 219, 490C.
College of Agriculture—Public Service and Administration in Agriculture

The curriculum in Public Service and Administration in Agriculture is designed for students who desire an interdisciplinary education to pursue a career with agriculturally related governmental and private agencies, or with businesses and industries which are concerned with public services in agriculture. Students will explore the planning and implementing of agriculturally related programs in communities (town, city, or county), multi-county areas, states, regions, and at the federal level.

The curriculum has a broad base of general education subjects including credits in communications, mathematics, physical and biological sciences, and the social sciences and humanities. The technical subjects represent a combination of sociology, economics, government, and technical agriculture, with emphases in social and economic change, history of public services, complex organizations, inter-agency relationships, community leadership, community action, adoption and diffusion, group dynamics, land utilization, and political and legal behavior as they relate to agriculture.

Graduate Study

The department offers work for the degrees Master of Science and Doctor of Philosophy with majors in sociology and rural sociology and minor work for students majoring in other departments. Within the major of sociology, students may specialize in family, complex organization, population, research methods, community, social change, theory, and leisure and environmental resources. Within the sociology major students may specialize in anthropology at the Master's level.

The department stipulates no language requirement for either the degree Master of Science or the degree Doctor of Philosophy. However, it may be relevant in individual cases to specify competence in one or more languages.

The department is a cooperating department in the industrial relations program. (See Industrial Relations.)

Courses open to graduate students for minor credit only:


COURSES PRIMARILY FOR UNDERGRADUATE STUDENTS

Courses in Sociology

110. ORIENTATION TO PUBLIC SERVICE AND ADMINISTRATION IN AGRICULTURE. (1-0) Cr. R; F. Survey of public service and administration in agriculture.

130. RURAL INSTITUTIONS AND ORGANIZATIONS. (4-0) Cr. 4. F.W.S. Analysis of basic institutions and organizations found in rural society. Emphasis on structure, functions, and social change in nonmetropolitan institutions. Effects of group relations on human behavior. Not open to students with credit in 134.

134. INTRODUCTION TO SOCIOLOGY. (3-0) Cr. 3. F.W.S.SS. Analysis of the effects of group relations on human behavior; interrelations of personality, group, community, and culture; major social processes, practical study of society. Not open to students with credit in 134.

135. SOCIAL PROBLEMS. (3-0) Cr. 3. F.W.S.SS. Prerequisite: 130 or 134. Nature and meaning of social problems; inclu-
SOCIAL RELATIONS

340. RACE AND MINORITY GROUP RELATIONS. (3-0) Cr. 3. F.W.S.SS.
Prerequisite: 130 or 134.
Minority groups and social structure; analysis of causes and consequences of group conflict with emphasis upon prejudice and discrimination in the United States.

302. RESEARCH METHODS IN SOCIOLOGY. (3-0) Cr. 3. F.W.S.SS.
Prerequisite: 130 or 134.
Research design, field procedures and analysis of data.

304. INTRODUCTION TO SOCIAL ECOLOGY AND POPULATION STUDIES. (3-0) Cr. 3. F.W.S.SS.
Prerequisite: 130 or 134.
Size, composition, and distribution of human populations; determinant causes and consequences of population change; examination of basic social and ecological concepts.

SOCIAL INTERACTION

305. SOCIAL INTERACTION. (3-0) Cr. 3. F.W.S.SS.
Prerequisite: 130 or 134.
Dynamics of social relations; analysis of human behavior in group situations.

COMMUNITY

310. COMMUNITY. (3-0) Cr. 3. F.S.SSI.
Prerequisite: 130 or 134.
Comparative analysis of the institutional structure of rural, urban, and suburban communities; community as an ecological and social system; power relationships.

SOCIAL STRATIFICATION

330. SOCIAL STRATIFICATION. (3-0) Cr. 3. F.W.S.SS.
Prerequisite: 130 or 134.
Theories of social stratification and social class; caste, estate, and class stratification systems in various social structures; analysis of studies of class in America; types and measurements of mobility.

SOCIOLOGY OF POVERTY

331. SOCIOLOGY OF POVERTY. (3-0) Cr. 3. S.
Prerequisite: 130 or 134.
Conditions of poverty; determination of poverty levels; studies of inequality, concentrating on the poor; attitudes toward poverty.

CONFLICT AND ACCOMMODATION

332. CONFLICT AND ACCOMMODATION. (3-0) Cr. 3. F.
Prerequisite: 130 or 134.
Functions of social conflict, strategies and techniques of conflict and accommodation, distribution of power, societal mechanisms for conflict management and resolution.

SOCIOLOGY OF COMPLIANCE

340. SOCIOLOGY OF COMPLIANCE. (3-0) Cr. 3. F.W.S.SSI.
Prerequisite: 130 or 134.
Analysis of society’s regulatory processes through socialization and social control, ways individuals develop perceptions toward a criminal justice system, facilitation of this process by societal reactions.

SOCIOLOGY OF DEVIANCE

341. SOCIOLOGY OF DEVIANCE. (3-0) Cr. 3. F.W.S.SSI.
Prerequisite: 130 or 134.
Meaning, identification, and causes of deviance; recruitment from deviant to normal identities; role of social institutions in correction, control, and prevention of deviance.

GROUP DYNAMICS

364. GROUP DYNAMICS. (2-3) Cr. 3. F.W.S.
Prerequisite: 130 or 134.
Planning and conducting group activities; relation of group dynamics and group techniques to group productivity; laboratory, group analysis, field practices.

SOCIAL RELATIONS IN INDUSTRY

380. SOCIAL RELATIONS IN INDUSTRY. (3-0) Cr. 3. F.W.S.
Prerequisite: Six credits in sociology.
Work, worker adjustment and alienation, constraints of technique, formal and informal aspects of work organizations.

SOCIETY AND THE URBAN

382. SOCIOLOGY OF AGRICULTURAL MARKETING FIRMS. (3-0) Cr. 3. S.
Prerequisite: 130 or 134.
Sociological analysis of merchandising, marketing, and management in local retail agriculture supply and marketing firms. Analysis of retail firms, their relation to the distribution system and to consumers.

SOCIETY AND RURAL LIFE

389. SOCIOLOGY OF RURAL LIFE. (3-0) Cr. 3. F.
Prerequisite: 130 or 134.
Changing characteristics of rural society; human relationships, values, institutions affected by changing population, technology and agricultural practices.

SOCIETY AND THE URBAN

390. SOCIETAL CHANGE AND DEVELOPMENT. (3-0) Cr. 3. S.
Prerequisite: 130 or 134.
Contemporary changes in rural and urban society with analysis of social institutions, social organizations, and social values. Theories of societal change. Adequacy of existing social structures to meet needs of people. Alternative development strategies and strategies to meet changing needs.

ADOP TION AND DIFFUSION OF INNOVATIONS

392. ADOPTION AND DIFFUSION OF INNOVATIONS. (3-0) Cr. 3. W.
Prerequisite: 130 or 134.
Processes of adoption and diffusion of innovations. Factors related to differential rates of adoption of new technology, such as sources of information, attitudes, values, knowledge, and personal and social characteristics.

ANALYSIS OF COMPLEX ORGANIZATIONS

393. ANALYSIS OF COMPLEX ORGANIZATIONS. (3-0) Cr. 3. F.
Prerequisite: 130 or 134.
Organizations as bureaucratic social systems. Emphasis on creation of organizations and agencies and their internal operations; linkages among agencies and to the general public.

HISTORY OF SOCIOLOGICAL THOUGHT

400. HISTORY OF SOCIOLOGICAL THOUGHT. (3-0) Cr. 3. W.
Prerequisite: Nine credits in sociology.
Origin and development of sociological thought from earliest times to 1860.

CONTEMPORARY SOCIOLOGICAL THEORIES

401. CONTEMPORARY SOCIOLOGICAL THEORIES. (3-0) Cr. 3. W.S.SSI.
Prerequisite: Twelve credits in sociology.
Analysis of major theories from 1860 to present.

URBAN SOCIETY

410. URBAN SOCI OLOGY. (3-0) Cr. 3. F.W.S.SS.
Prerequisite: 130 or 134.
Growth, structure, and functions of the city; urban-societal relations.

SYSTEMS ANALYSIS OF CRIMINAL AND JUVENILE JUSTICE

440. SYSTEMS ANALYSIS OF CRIMINAL AND JUVENILE JUSTICE. (3-0) Cr. 3. W.
Prerequisite: 340.
Criminal and Juvenile Justice: detection, labeling and arrest, prosecution, adjudication, sentencing, imprisonment, release, revocation.

DEMOGRAPHIC ANALYSIS

Prerequisite: 130 or 134.
Dynamics of population development with emphasis on theories of population; fertility, mortality, and migration as components of population change; techniques of measurement of demographic phenomena; projection of population trends.
450. HUMAN ECOLOGY. (3-0) Cr. 3. F.W.S.S. SSI. 1973, SSII. 1972.
Prerequisite: 130 or 134.
Development of human ecology as a discipline and its relationship to general ecology; basic concepts, theories, and methods developed by human ecologists as applied to the study of cities, community structure, social areas, and sociocultural elements as determinants of man's relationship to environment; the ecosystem as a frame of reference.

454. FIELD OBSERVATION AND PRACTICE. Cr. 1 to 3 each time taken. F.W.S.S.S.
Prerequisite: Nine credits in sociology.
Supervised practice in established organizations and agencies.
A. Rural Organizations and Group Work Agencies.
B. Industrial Plants and Related Organizations.
C. Family Life Education and Agencies.

460. OBSERVATION AND PRACTICE IN CRIMINAL AND JUVENILE JUSTICE. Cr. 1 to 3 each time taken. W.S.
Prerequisite: 440.
Study of deviant behavior and social control in a correctional institution, in a probation office, or in a field service agency.

461. INTRODUCTION TO SOCIAL WORK. (3-0) Cr. 3. F.
Prerequisite: Nine credits in sociology.
Policy issues, comparative institutional materials (historical and cross-cultural), normative and organizational structure.

462. INTRODUCTION TO SOCIAL WORK. (3-0) Cr. 3. W.
Prerequisite: 461.
Current theories and practices in social case work, group work, and community organization.

463A. 463B. SOCIAL WORK SKILLS AND FIELD PLACEMENT. Cr. 5 each. 463A: W; 463B: S.
Prerequisite: 463A: Concurrent registration in 462, permission of instructor; 463B: 463A.
463A: Specific principles and methods of social work. 463B: Field placement in selected welfare agencies under professional supervision. It is strongly recommended that students who take 463A take 463B as well.

464. COMMUNITY ACTION. (3-0) Cr. 3. F.W.S.S.SSI.
Prerequisite: 202.
Community analysis of mobilization and organization of human and social system resources for social action programs.

471. SOCIOLOGY OF EDUCATION. (3-0) Cr. 3. F.W.S.S.S.
Prerequisite: 130 or 134; Educ. 204 for education majors.
American schools as social organizations, as community institutions, and as socialization agents.

473. SOCIOLOGY OF YOUTH. (3-0) Cr. 3. W.S.S.SII.
Prerequisite: 130 or 134.
Social analysis of the development of self, integration into adult society, effect of peer and sibling relationships, the social implications of youth transitions into adult culture.

480. INDUSTRIAL SOCIOLOGY. (3-0) Cr. 3. F.
Prerequisite: 380.
Implications of technological change on modern industrial organizations.

482. SOCIAL BEHAVIOR AND ENVIRONMENTAL RESOURCES. (3-0) Cr. 3. F.S.S.SII.
Prerequisite: 130 or 134; Biol. 103 recommended.
Natural resource problems, value orientations toward the environment, environmental quality and quantity as social problems, conservation as a social movement, organizational patterns in resources management.

483. SOCIOLOGY OF LEISURE AND RECREATION. (3-0) Cr. 3. W.S.S.S.
Prerequisite: 130 or 134.
The social significance of leisure, the human values in leisure-time pursuits, evaluation of current uses of leisure, the social institutional structure and functional systems of society related to leisure behavior.

485. SOCIOLOGY OF THE FAMILY. (3-0) Cr. 3. F.W.S.S.
Prerequisite: 130 or 134.
Analysis of the family as a group; cultural influences, group processes, and institutional aspects.

486. LEADERSHIP AND SOCIAL INTERACTION. (3-0) Cr. 3. W.S.S.S.
Prerequisite: 130 or 134.
Genesis of leadership, leader-follower roles and leader types in modern society, case studies of contemporary theories. A sociological analysis of community leadership. Review of findings relative to formal and informal leadership patterns in the community organizations. Implications of leadership patterns for community action.

490. SPECIAL PROBLEMS. Cr. 1 to 5 each time taken.
Prerequisite: Nine credits in sociology.
A. General Sociology.
B. Rural Sociology.
C. Social Problems.
D. Industrial Sociology.
E. Family Sociology.
H. Honors.
J. Senior Seminar.

*Administered through the College of Agriculture.
Courses not marked by an asterisk are administered through the College of Sciences and Humanities.

COURSES PRIMARILY FOR GRADUATE STUDENTS, major or minor, open to qualified undergraduates.

Courses in Sociology

501, 502. INTERMEDIATE THEORETICAL ANALYSIS. (3-0) Cr. 3 each. 501: W; 502: S.
Prerequisite: 503.
501: Contemporary theories in micro-sociology with emphasis on symbolic interactionism. 502: Contemporary theories of macro-sociology with emphasis on social change in communities, societies, and general social systems.

503. INTERMEDIATE SOCIOCOLOGICAL INQUIRY AND THEORY. (3-0) Cr. 3. F.
Prerequisite: 401.
Science and sociology. Units of sociological analysis. Taxonomies in sociology; concepts, sub-concepts, levels of concepts. Elements of systematic sociological theory; propositions, explanation, prediction, cause. Use of sociological theory in research.
COURSES PRIMARILY FOR UNDERGRADUATE STUDENTS

Courses in Anthropology

111. INTRODUCTION TO ANTHROPOLOGY.
(3-0) Cr. 3. F.W.S.SS.
Introduction to anthropological analysis of man: scope, methods and subfields of anthropology. An integrated biocultural approach to the understanding of man through time and space.

218. CULTURAL ANTHROPOLOGY.
(4-0) Cr. 4. F.W.S.SS.
Prerequisite: 111.
Anthropological concepts and techniques for understanding world cultural similarities and differences; universals aspects of human experience, including the family, economic, political, and religious systems examined in cross-cultural perspective.
219. PHYSICAL ANTHROPOLOGY.
(3-2) Cr. 4. W.
Prerequisite: 111.
Human origins, fossil man, differentiation into races; physical anthropology of the living; interplay of biological and cultural factors in human evolution.

220. ARCHAEOLOGY.
(3-2) Cr. 4. F.
Prerequisite: 111.
Origin and development of culture from Paleolithic assemblages through the beginnings of civilization; world prehistory by major culture areas.

313. THE FAMILY IN CROSS-CULTURAL PERSPECTIVE.
(3-0) Cr. 3. S.
Prerequisite: 111.
A comparative survey of cultural patterns and social institutions on a world-wide basis; representative groups within a framework of culture areas.

321. COMPARATIVE STUDIES OF WORLD CULTURES.
(3-0) Cr. 3. S.
Prerequisite: 111.
A comparative survey of cultural patterns and social institutions on a world-wide basis; representative groups within a framework of culture areas.

322. THE AMERICAN INDIAN.
(3-0) Cr. 3. W.
Prerequisite: 111.
Origin and distribution of New World populations; survey of culture areas and patterns of the native peoples of North America; problems of contact and acculturation.

323. CONTEMPORARY LATIN AMERICAN CULTURES.
(3-0) Cr. 3. Alt. F, offered 1971.
Prerequisite: 111.
Cultural backgrounds of contemporary groups in Middle and South America; historic and present socio-cultural systems of Indian, Negro, and Mestizo groups; institutionalized values in Latin American culture.

325. NATIVE PEOPLES OF MIDDLE AND SOUTH AMERICA.
(3-0) Cr. 3. Alt. F, offered 1972.
Prerequisite: 111.
Origins and distribution of native populations in Middle and South America; survey of cultural patterns of different ethnic groups; Aztec, Maya, and Inca civilizations; anthropological approaches to problems of aboriginal American culture history; European contact and acculturation.

333. ANTHROPOLOGICAL PERSPECTIVES ON BLACK AMERICA.
(3-0) Cr. 3. F.B.
Prerequisite: 111, permission of instructor.
Race relations in the American; ethnological approaches to their study in cross-cultural and historical perspective; contemporary ethnography of Blacks in the U.S.

340. ANTHROPOLOGICAL PERSPECTIVES OF RELIGION.
(3-0) Cr. 3. W.8811.
Prerequisite: 111.

400. LANGUAGE AND CULTURE.
(3-0) Cr. 3. Alt. W, offered 1972.
Prerequisite: 218.
Structure and design of language; language and cognition; semantics; linguistic change; social and linguistic aspects of verbal behavior; language, world view, and cognitive style.

420. ARCHAEOLOGY OF NORTH AMERICA.
(3-0) Cr. 3. S.
Prerequisite: 220 or 322.
Prehistory and early history of North America as reconstructed from archaeological evidence, prehistory of the New World, major cultural historical developments north of the Rio Grande.

421. KINSHIP IN DIFFERENT CULTURES.
(3-0) Cr. 3. S.
Prerequisite: 218 or 313.
Kinshp theory, comparative analysis of kinship systems, structure and functions of kinship relations in various cultures.

422. CULTURE AND PERSONALITY.
(3-0) Cr. 3. F.
Prerequisite: 218, Psych. 101.
Relationship of cultural, social, and personality factors in human behavior; analysis of generational transmission of culture.

424. ETHNOLOGY OF THE OLD WORLD.
(3-0) Cr. 3. W.
Prerequisite: 218.
Selected old world cultures: Africa, Europe, Asia, or Oceania.

426. ARCHAEOLOGY OF EUROPE AND THE NEAR EAST.
(3-0) Cr. 3. Alt. W, offered 1973.
Prerequisite: 220.
Prehistoric and early literate cultures of Europe as reconstructed from archaeological evidence, prehistoric background of Near Eastern and Mediterranean civilizations.

428. ARCHAEOLOGICAL LABORATORY METHODS AND TECHNIQUES.
Cr. 1 to 5. F.W.S.
Prerequisite: Three credits in anthropology, permission of instructor.
Laboratory processing and analysis of archaeological materials, preparation of preliminary archaeological report.

429. ARCHAEOLOGICAL FIELD SCHOOL.
Cr. 8 to 12. B.B., 8-10 weeks.
Prerequisite: Three credits in anthropology, permission of instructor.
Summer field school for training in archaeological reconnaissance and excavation techniques; documentation and interpretation of archaeological evidence.

430. ETHNOLOGICAL FIELD METHODS.
(3-0) Cr. 3. Alt. F, offered 1971.
Prerequisite: 218, six additional credits of anthropology or sociology or combination.
Concepts and strategies of anthropological field work, participant observation, theory and method in collection and analysis of ethnographic information.

490. SPECIAL PROBLEMS.
Cr. 1 to 5 each time taken.
Prerequisite: Nine credits in anthropology.
A. Archaeology.
B. Cultural Anthropology.
C. Physical Anthropology.
H. Honors.
COURSES PRIMARILY FOR GRADUATE STUDENTS, minor only, open to qualified undergraduates

Courses in Anthropology

510. SOCIAL ANTHROPOLOGY. (4-0) Cr. 4. S.
    Prerequisite: 218; 340 or 421; 322 or 424.
    Historical development of social anthropology, systematic survey of the structuralist-functionalist approach, special analysis of social structure and social organization.

520. CULTURAL CONTINUITY AND CHANGE IN THE PRAIRIE-PLAINS. (3-0) Cr. 3. Alt. W, offered 1972.
    Prerequisite: 322 or 420 or 429; 426.
    Ecological adaptations and sociocultural change among Prairie and Plains Indian groups through time.

529. ADVANCED ARCHAEOLOGICAL METHODS. Cr. 1 to 6. F.W.S. May be taken for 8 to 12 credits in summer field school.
    Prerequisite: 428, permission of instructor.
    Archaeological field techniques and laboratory methods. Reconstruction of sociocultural activities from archaeological evidence.

530. FIELD PROBLEMS IN THE ETHNOGRAPHY OF CONTEMPORARY SOCIETIES. Cr. 1 to 5. F.W.S. May be taken for 8 to 12 credits in summer field school.
    Prerequisite: 430, permission of instructor.

Field training experience in ethnography, problems emphasizing field studies in the contemporary societies of the world.

    Prerequisite: Nine credits in anthropology, permission of instructor.
    Historical development of anthropological theories and concepts; systematic survey of major theoretical areas of social and cultural anthropology; nature of anthropology as a discipline.

590. SPECIAL TOPICS. Cr. 1 to 5.
    Prerequisite: Fifteen credits in anthropology; senior or graduate classification.
    A. Archaeology of New World.
    B. Archaeology of Old World.
    C. Biological Anthropology of New World.
    D. Biological Anthropology of Old World.
    E. Cultural-Social Anthropology of New World.
    F. Cultural-Social Anthropology of Old World.
    G. Linguistic and Cognitive Anthropology of New World.

Courses FOR GRADUATE STUDENTS, minor only

Courses in Anthropology

698. ADVANCED TOPICS IN ANTHROPOLOGY. (3-0) Cr. 3 each.
    A. General Anthropology.
    B. Archaeology.
    C. Cultural Ecology.
    D. Applied Anthropology.
    E. Economic Anthropology.
    F. Psychological Anthropology.
    G. Political Anthropology.
    H. Urban Anthropology.
    I. Magico-Religious Systems.
    J. Kinship Studies.

699. RESEARCH.

SOIL SCIENCE

For description of courses, see Agronomy.

SPAN

Advisory Committee: Chalmer J. Roy, Ph.D., Chairman; Arthur M. Gowan, Ph.D.; Millard R. Kratochvil, M.A.

Student Project for Amity among Nations (SPAN) is a program of carefully supervised individual foreign study. Participants spend one academic year planning research projects and gaining background on the country to be visited. Field studies require at least eight weeks abroad during the summer. During the following academic year participants prepare a report on their investigation and devote appropriate effort to the promotion of SPAN.

Total credits offered are 12: 6 for preparation and the field study, 6 for the report and SPAN activity. Grades for the first 6 credits are determined by the group adviser; for the final 6 credits the grades are determined jointly by the project counselor and the group adviser. Classification may be in university studies courses or in appropriate formal or special problems courses.
SPEECH
William R. Underhill, Ph.D., Chairman of Department

Professors: Frank E. Brandt, M.S.; George P. Wilson, Jr., Ph.D.

Associate Professor: M. Burton Drexler, Ph.D.


Undergraduate Study
The department offers introductory courses designed for all students as part of their general education, as a complement to professional training, or as an introduction to further study in the field.

A student electing to major in speech may submit, in consultation with his adviser, a program for the degree Bachelor of Arts. This program of courses may emphasize any one of the following options: rhetoric and public address, telecommunicative arts, or dramatic arts. With any one of these the student may also prepare for a career in teaching. For the general requirements of the college, see Sciences and Humanities, Curriculum.

Basic instruction in the department is designed to establish proficiency in the oral communication necessary for successful college work and requisite to the demands of personal, professional, and civic life.

Major study in speech can prepare the student for a wide variety of employment opportunities depending upon his interests, background, and abilities. Students can prepare to teach speech and dramatic arts in the secondary schools. (See College of Education.) Students can prepare for professional work in theatre, radio, television or film, and in such related fields as sales, public relations, and publicity. Programs in speech prepare students for graduate study in the various areas of speech at the college or university level. An undergraduate speech major may be used as a background for premedical, prelegal, and pretheological studies as well as for advanced study in speech pathology. Some students select speech as a major in the pursuit of their liberal arts education.

The department offers a speech and hearing clinic for students with individual speech or hearing problems. The clinicians are departmental staff members with special training and qualifications in speech and hearing therapy.

Students who major or minor in speech are encouraged to participate in the extracurricular activities sponsored by the department. These activities include the Iowa State Debaters, Iowa State Players, and Radio Workshop. Students with a primary interest in speech also are frequently invited to act in theatre productions and in student-directed telecommunicative arts programs.

Graduate Study
Courses open to graduate students for minor credit only are: 327, 329, 375, 376, 378, 385, 400A, 400B, 400C, 431, 432, 465, 478.

COURSES PRIMARILY FOR UNDERGRADUATE STUDENTS

15. REMEDIAL SPEECH.
(0-2) Cr. 0. F.W.S.
Prerequisite: Permission of instructor.
Analysis of the student's speech handicaps followed by intensive training or therapy in the speech clinic.

106. THE PERFORMING ARTS.
(3-0) Cr. 3. F.W.S.
Theatrical theory and practice and its influence on other performing arts.
207. **VOICE AND DICTION.**  
(3-0) Cr. 3. F.W.S.SSI.  
Development of effective speech habits: voice quality, articulation, pronunciation. Individual improvement programs.

208. **PHONETICS.**  
(3-0) Cr. 3. F.W.S.  
American speech sounds and the international phonetic alphabet, exercises in diction and phonetic transcription.

211. **FUNDAMENTAL PRACTICE OF SPEECH.**  
(3-0) Cr. 3. F.W.S.SSI.  
Prerequisite: Engl. 105 or 132.  
Principles of public speaking, audience analysis, interest and attention, selection and organization of speech material, delivery. Practice in preparation and delivery of extemporaneous speeches.

215. **PARLIAMENTARY PROCEDURE.**  
(1-2) Cr. 2. F.W.S.  
Principles and forms of parliamentary action governing conduct of meetings. Practice in procedures for small groups as well as for larger deliberative assemblies.

223. **INTERCOLLEGIATE DEBATE AND FORENSICS.**  
Cr. 1 to 3 each time taken, maximum of 6 credits. F.W.S.  
Participation in intramural or intercollegiate debate and other forensic events.

230. **TELECOMMUNICATIVE ARTS SEMINAR.**  
(1-0) Cr. R; F.W.S.  
Orientation to mass media of television, radio, and film; guest lecturers from fields of commercial and educational broadcasting and film; viewing and discussion of selected videotaped television programs; informational and educational films.

233, 234, 235. **TELEVISION WORKSHOP.**  
(0-4) Cr. 2 each. F.W.S.SSI.  
Prerequisite: 234: 233; 235: 234.  
233: Duties of the television director and the production team; laboratory practice in use of studio and television equipment.  
234: Intermediate television production involving studios of Exhibit Hall and WOI-TV.  
235: Extensive laboratory experience in television direction, audio and camera operation, utilizing speaking and performance projects.

237, 238. **DEVELOPMENT OF THE MOTION PICTURE.**  
(2-2) Cr. 3 each. 237: F; 238: W.  
Prerequisite: Engl. 105 or 132.  
237: Early development of motion pictures; individuals responsible for major advances in theory and techniques.  
238: Recent developments and social trends in motion pictures.

241. **RADIO WORKSHOP.**  
Cr. 1 to 3 each time taken, maximum of 6 credits. F.W.S.  
Prerequisite: Engl. 105 or 132, permission of instructor.  
Introduction to radio techniques in announcing, writing, acting, use of sound and music. Practice in integrating the various audio elements in the actual production of radio programs.

250. **DRAMATICS.**  
Cr. 1 to 3 each time taken, maximum of 6 credits. F.W.S.SSI.  
Prerequisite: Permission of instructor.  
Practice in acting, directing, costuming, makeup, scene construction, painting, or scene design.

251. **BEGINNING ACTING.**  
(3-0) Cr. 3. F.W.S.  
Theory and practice in fundamentals of acting including focus, recall, imagination, and characterization, with emphasis on pantomime and improvisation.

305. **GENERAL SEMANTICS.**  
(3-0) Cr. 3. F.W.S.SSI.  
Prerequisite: Engl. 105 or 132.  
Nature of symbolic processes; influence of verbal habits in human affairs; relationships between language and personal or social problems; accuracy in the use of verbal symbols.

309. **ORAL INTERPRETATION.**  
(3-0) Cr. 3. F.W.S.  
Principles of oral interpretation; practice in analysis and reading aloud of literary selections.

310. **BUSINESS AND PROFESSIONAL SPEAKING.**  
(3-0) Cr. 3. F.W.S.  
Fundamental principles in oral communication for common types of professional speeches; extensive use of video recorder for diagnostic analysis of delivery.

313. **SPEECH FOR THE CLASSROOM TEACHER.**  
(3-0) Cr. 3. F.S.  
Prerequisite: 211.  
Oral communication in the teaching profession; training in classroom-oriented communication activities; extensive use of video recorder for analysis of presentation.

317. **GROUP DISCUSSION.**  
(3-0) Cr. 3. F.W.S.  
Prerequisite: 211.  
Practice and procedures of problem-solving groups; communication theories related to group procedure and participation.

318. **LEADERSHIP IN GROUP DISCUSSION.**  
(3-0) Cr. 3. S.  
Prerequisite: 211.  
Theories of group leadership in the specialized groups, forms of group discussion, symposiums, role-playing, forums.

319. **MOTION PICTURE TECHNIQUES.**  
(JL 319.) See Journalism and Mass Communication.

322. **ARGUMENTATION.**  
(3-0) Cr. 3. F.S.  
Practice in preparing and presenting argumentative speeches; emphasis on ethical and logical duties of the advocate; analysis, evidence, reasoning, attack, and defense.

323. **DEBATE.**  
(3-0) Cr. 3. W.  
Debate fundamentals: emphasis on research, case construction, and judging; practice in various debate forms.

327. **PERSUASION.**  
(3-0) Cr. 3. F.W.S.  
Prerequisite: 211.  
Examination of behavioral research in persuasion; scientific methods of evaluating persuasive communication; emphasis on application of experimental research.

329. **PERSUASIVE SPEAKING.**  
(3-0) Cr. 3. S.  
Prerequisite: 327.  
Audience analysis, attention, perception, suggestion, logical and emotional proof; ethics of a persuasive speaker; use of videotape for analysis.

331. **TELEVISION AND RADIO BROADCASTING.**  
(3-0) Cr. 3. W.  
Prerequisite: Engl. 105 or 132.  
The American structure of radio-television and related industries; analysis of types of programs; role of broadcast media in education, entertainment, and public service; standards of evaluation.
332. **TELEVISION AND RADIO SPEECH.**
   (3-0) Cr. 3. F.W.S.
   Prerequisite: Engl. 105 or 132.
   Theory and practice of effective television and
   radio speaking under closed circuit conditions.

337. **TELEVISION PERFORMANCE.**
   (1-4) Cr. 3. W.S.
   Prerequisite: 207.
   Problems of the television performer; adaptations
   in composition and interpretation which the me-
   dium requires of the announcer, narrator, master
   of ceremonies, or actor. Studio situations de-
   signed to aid student in improving his perform-
   ance skills.

348. **INFORMATIVE WRITING FOR RADIO AND TELEVISION.**
   (Jt. 348) See Journalism and Mass Communi-
   cation.

355. **DRAMATIC PRODUCTION.**
   (3-0) Cr. 3. F.W.S.
   Prerequisite: 106.
   Principles of play production; choosing the play,
   casting, rehearsing, staging, and lighting.

356. **COSTUMING FOR STAGE, TELEVISION, AND FILM.**
   (3-0) Cr. 3. F.
   Prerequisite: Sophomore standing.
   Costume design and construction; techniques
   of costuming; use of color and materials in theatre,
   television, and film costumes.

360. **STAGECRAFT.**
   (2-2) Cr. 3. F.W.
   Prerequisite: Sophomore standing.
   Technical drawings for constructing scenery;
   tools, materials, and techniques in constructing
   and painting scenery.

362. **CREATIVE DRAMATICS.**
   (3-0) Cr. 3. W.S.
   Prerequisite: Junior standing, permission of
   instructor.
   Improvisation and playmaking with children and
   adults in the school, home, and community;
   emphasis on the elementary and preschoolchild.

363. **PLAY SELECTION.**
   (3-0) Cr. 3. 8.
   Prerequisite: 106.
   Study of plays suitable for production by school
   and community groups.

369. **SUMMER THEATRE PRACTICUM.**
   Cr. 1 to 6 each time taken, maximum of 12
   credits. 88.
   Prerequisite: Permission of instructor.
   Practicum in summer stock or repertory theatre
   involving production, rehearsal, and performance
   with opportunities for specialization in various
   areas.

375. **SPEECH CORRECTION PRINCIPLES.**
   (3-0) Cr. 3. F.W.S.S.S.S.
   Prerequisite: 211.
   Speech disorders found among school children;
   methods which the classroom teacher can em-
   ploy in handling these disorders; referral and
   cooperation with the speech therapist.

376. **ARTICULATION DISORDERS.**
   (3-0) Cr. 3. F.W.
   Prerequisite: 376.
   Etiology, nature, and treatment of articulation
   disorders.

378. **STUTTERING.**
   (3-0) Cr. 3. W.
   Prerequisite: 375.
   Study of theories and research on stuttering
   behavior and methods of management.

385. **AUDIOLOGY.**
   (3-0) Cr. 3. 8.
   Prerequisite: 375.

390A. **PROGRAMS IN ADVANCED ORAL INTERPRETATION.**
   (2-2) Cr. 3. W.
   Prerequisite: 309.
   Interpretative reading programs: Readers’ Thea-
   tre, Chamber Theatre, lecture recital, and
   others.

412. **SPEECH CRITICISM.**
   (3-0) Cr. 3. 8.
   Prerequisite: Nine credits in Spanish.
   Development of speech theory and practice from
   Corax to modern times. Application of prin-
   ciples of criticism to current public speaking prac-
   tices.

431. **TELEVISION PRODUCTION.**
   (3-0) Cr. 3. F.
   Prerequisite: 234, 337.
   Theory and practice of television production.
   Programs analyzed with reference to staging,
   lighting, sound, shooting, and switching.

455. **DIRECTING PLAYS.**
   (3-0) Cr. 3. 8.
   Prerequisite: 356, 358.
   Directing plays with special attention given to
   problems of casting, rehearsal, blocking, move-
   ment, picturization, style, mood, and character
   business.

465. **HISTORY OF THEATRE.**
   (3-0) Cr. 3. F.
   Prerequisite: 106.
   Theatrical art from ancient times through the
   Middle Ages.

478. **LANGUAGE DISORDERS OF CHILDREN.**
   (3-0) Cr. 3. W.
   Prerequisite: 375.
   Normal language development, bases and diag-
   nosis of language disorders in children, method-
   ologies for habilitating children with language
   disturbances.
490. SPECIAL PROBLEMS.
Cr. 2 to 5 each time taken.
Prerequisite: Twelve credits in speech, junior classification, permission of department chairman.
A. Rhetoric and Public Address.
B. Speech Correction.
C. Theatre.
D. Speech Education.
E. Radio, Television, and Film.
H. Honors.

495. THE TEACHING OF SPEECH.
(Educ. 495) (3-0) Cr. 3. W.
Prerequisite: Educ. 305A, 305B, quality point average of 2.5 in 9 credits of speech courses designated by the department.
Problems, methods, and materials related to the teaching of speech in the secondary school. Particular attention to the extracurricular program.

COURSES PRIMARILY FOR GRADUATE STUDENTS, minor only, open to qualified undergraduates

510. CLASSICAL RHETORIC.
(4-0) Cr. 4. W.
Prerequisite: 412.
Greek and Roman tradition in rhetorical theory, practice, criticism, and pedagogy.

556. DIRECTING THE EDUCATIONAL THEATRE PROGRAM.
(3-0) Cr. 3. SSI.
Prerequisite: Graduate standing, permission of instructor.
Problems in directing educational theatre, play selection and new dramatic literature, theatre management, directing college and high school drama programs, conducting high school drama contests and festivals.

STATISTICS
Theodore A. Bancroft, Ph.D., Head of Department


Associate Professors: Barry Arnold, Ph.D.; Richard Groeneveld, Ph.D.; Chien-Pal Han, Ph.D.; C.C. Mosier, B.S.; Edward Pollak, Ph.D.; Richard D. Warren, Ph.D.

Assistant Professors: Harold Baker, M.S.; Jon Beadelmann, Ph.D.; Roy Hickman, Ph.D.; Paul Hinz, Ph.D.; Dean Isaacson, Ph.D.; William J. Kennedy, Jr., Ph.D.; Glen Meeden, Ph.D.; Richard Mensing, Ph.D.; Abel G. Mexas, Ph.D.; Vincent Sposito, Ph.D.; Shashikala Sukhatme, Ph.D.

Instructors: George Battese, M.S.; Mary Ann Chamberlain, M.S.; John C.W. Lin, M.S.; Jeff Meeker, M.S.; John Schmid, M.S.; James Veale, M.S.

Undergraduate Study
For the undergraduate curriculum in sciences and humanities, major in statistics, leading to the degree Bachelor of Science, see Sciences and Humanities, Curriculum. For the undergraduate curriculum in biometry see Agriculture, Curricula.

The curriculum in sciences and humanities with a major in statistics is designed to prepare students for (1) graduate study in statistics, and (2) positions as assistants to research workers in business, industry, or government. This work may include the following: statistical design, analysis, and interpretation of experiments and surveys; statistical quality control; sample inspection; high-speed data processing; application of statistical principles and methods to industrial research and development and to industrial design and specifications; operations research to analyze the performance of men, machines, and processes under operational conditions; market, sales, advertising, and consumer research; cost and price analyses; newspaper, magazine, radio, and television research; psychological testing; public health studies. Also, there are opportunities for work in statistics that require a major in a subject-matter field and a minor in statistics.
Undergraduate majors in this department usually include the following basic courses in their programs: 101, 341, 342, 343, 380, 401, 402, 411, 421, 482. A minor is ordinarily taken in mathematics and consists of Math. 213 and at least three additional courses in mathematics numbered 300 or higher. It is also advisable to have a strong minor in a field of application. These lists of courses are not to be regarded as statements of fixed requirements or as complete outlines of the work necessary for the major. They are given solely for the convenience of students or advisers who wish to estimate the amount of basic, nonspecialized study which may be needed.

The curriculum in biometry is intended for those students who desire to apply mathematics and statistics to problems related to agriculture. The curriculum prepares the student to work with research scientists in agriculture or for graduate study in related fields.

Students intending to do graduate work in statistics normally would take additional courses in mathematics.

Graduate Study

The department offers work for the degrees Master of Science and Doctor of Philosophy with major in statistics, and minor work to students taking major work in other departments. Prerequisite to major graduate work is the completion of an undergraduate curriculum essentially equivalent to the curriculum in Sciences and Humanities at this institution, together with a year of calculus and a knowledge of statistical theory and methods as contained in Stat. 341, 342, 343, 401, 402.

The degree Master of Science may be earned on either a thesis or nonthesis basis. The nonthesis option requires the completion of at least 51 credits of acceptable graduate work and satisfactory performance on a written examination.

There is no uniform language requirement for graduate students majoring in statistics. The department encourages the student to prepare himself in foreign languages and in computer language, but specific requirements for the degrees Master of Science and Doctor of Philosophy are at the discretion of the student's advisory committee.

Open to graduate students for minor credit only: 401, 402, 403, 411, 421, 431, 436, 447, 448, 481, 482, 490.

COURSES PRIMARILY FOR UNDERGRADUATE STUDENTS

100. ORIENTATION IN STATISTICS. (1-0) Cr. R; F.
Survey of the field for students planning or considering a career in statistics.

101. PRINCIPLES OF STATISTICS. (4-3) Cr. 5. F.W.S.
Statistical concepts in modern society; frequency distributions; elements of statistical inference; contingency tables; introduction to regression, correlation; analysis of variance, single classification.

104. INTRODUCTION TO STATISTICS. (2-3) Cr. 3. W.S.
Statistical concepts with emphasis on experimental problems from biological fields. For students in agricultural and biological sciences.

105. INTRODUCTION TO STATISTICS. (3-0) Cr. 3. F.S.
Prerequisite: Math. 110.
Statistical concepts with emphasis on engineering applications. Probability; elements of statistical inference; introduction to order statistics. For students in engineering.

127. BUSINESS ADMINISTRATION STATISTICS. (4-3) Cr. 5. F.W.S.
Obtaining, presenting, and organizing statistical data; measures of location and dispersion; the normal distribution; regression and correlation; time series analysis; index numbers; sampling and sampling distributions; tests of hypotheses.

327. ELEMENTARY BUSINESS STATISTICS. (2-3) Cr. 3. F.
Prerequisite: 101.
Application of statistical methods to business data obtained from random samples and from time series. Inference, decision theory, quality control, index numbers, forecasting, and simple Markov processes.

341. 342. 343. INTRODUCTION TO THEORY OF PROBABILITY AND STATISTICS. (3-0) Cr. 3 each. Yr.
Prerequisite: Math. 112.
Probability; distribution functions and their properties; sampling distribution; theory of estimation and tests of hypotheses; linear hypothesis theory, regression and correlation; the multivariate normal distribution; nonparametric methods.

380. STATISTICAL APPLICATIONS OF DIGITAL COMPUTERS. (Com.S. 380) (2-3) Cr. 3. F.W.S.
Prerequisite: 101; Com.S. 201 or knowledge of computer programming.
Techniques for using the computer as a tool in the analysis of statistical problems. Not open for credit to students who have had 481.

401. 402. STATISTICAL METHODS FOR RESEARCH WORKERS. (3-3) Cr. 4 each. 401: F.W.S.S; 402: W.W.S.S.
Prerequisite: 401; 101 or graduate classification. 5 credits in mathematics; 402: 401.
The role of statistics in research. Introduction to the methods of analyzing data from experiments and surveys. 401: Statistical concepts
and models; estimation; simple tests of significance; linear regression and correlation; introduction to analysis of variance. 402: Methods of analysis of variance including crossed classifications; introduction to multiple comparisons; factorials; individual degrees of freedom; multiple regression; covariance.

403. NONPARAMETRIC STATISTICAL METHODs.
(3-0) Cr. 3. Alt. F. offered 1972.
Prerequisite: 401.
Analytical procedures for statistical data when the dependent variable has ordinal or nominal properties; elaborations of chi-square procedures; randomization procedures for ranked data and data having interval properties; efficiency of nonparametric procedures and robustness of comparable parametric procedures.

411. EXPERIMENTAL DESIGN FOR RESEARCH WORKERS.
(3-0) Cr. 3. S.SSI.
Prerequisite: 402.
Methods of constructing and analyzing designs for experimental investigations; concepts of blocking, randomization, and replication; experimental unit technique; complete block designs; confounding in factorial experiments; incomplete block designs; response surface methodology.

421. SURVEY DESIGNS FOR RESEARCH WORKERS.
(3-0) Cr. 3. S.SSI.
Prerequisite: 401.
Methods of constructing and analyzing designs for survey investigations; simple random, stratified, multistage, and multivariate sampling designs; questionnaire construction; methods of estimation; techniques of survey investigation.

431. ELEMENTARY STATISTICAL QUALITY CONTROL.
(3-0) Cr. 3. S.
Prerequisite: 101 or 401; junior classification. Application of statistical principles to manufacturing. Survey of control chart technique and sampling inspection schemes now in use.

436. GENETIC STATISTICS FOR RESEARCH WORKERS.
(3-0) Cr. 3. S.
Prerequisite: 411.
Statistical concepts in quantitative genetics. Derivation, definition, and estimation of genetic parameters. Application of statistical models to the design, analysis, and interpretation of quantitative genetic experiments. Genetic and statistical implications of common selection procedures.

446. 447, 448. STATISTICAL THEORY FOR RESEARCH WORKERS.
(3-0) Cr. 3 each. 446: F; 447: W; SSI: 448: SSSI.
Prerequisite: 446: Math. 109; 447: 446 or Math. 112; 448: 447.
Primarily for graduate students not majoring in statistics. Emphasis on the aspects of the theory underlying statistical methods. Probability, population distribution functions and their properties, sampling distributions, orthogonal linear functions, estimation, tests of hypotheses, regression.

486 Courses and Programs

490. SPECIAL PROBLEMS.
Cr. var.
Prerequisite: Fifteen credits in statistics. H. Honors Program.

COURSES PRIMARILY FOR GRADUATE STUDENTS, major or minor, open to qualified undergraduates

501. INTERMEDIATE STATISTICAL METHODS.
(3-0) Cr. 3. F.
Prerequisite: 402. Bancroft.
Special situations in the analysis of variance; multiple comparisons; transformations; multiple covariance; fitting of polynomials and non-linear regression; Method of chi-square applications.

505. PSYCHOMETRICS.
(Psych. 505) (3-0) Cr. 3. S.
Theories of psychological scaling and measurement; derivation of formulas used in reliability experiments; useful approximation procedures.

506. FACTOR ANALYSIS.
(Psych. 506) (3-0) Cr. 3. F.
Prerequisite: 402. Wolins.
Derivation of procedures from the general model of factor analysis. Thurstone’s, Hotelling’s, and Lawley’s factorial methods. Criteria for significance of factor loadings and for testing for minimum rank. Factor rotation.

508. SOCIOMETRIC STATISTICS.
(3-0) Cr. 3. F.
Prerequisite: 402. Warren.
Sociological models, including linear models, and their application to sociological data. Criterion variables, selection of predictor variables, estimation, dummy variables, residuals, and causal inference. Methods of sociological scaling, index construction, and composite measures.

511, 512. DESIGN OF EXPERIMENTS.
(3-0) Cr. 3 each. 511: W; 512: S.
Prerequisite: 401, 448 or 541. Zyskind.
Intermediate theory of least squares; classification and functional models, estimability, missing observation procedures and the analysis of variance and covariance. Principles of statistical design for experimental investigations in biological, agricultural, and industrial research; tests; estimation; randomized blocks; Latin-squares; Graeco-Latin squares; 2^n, 3^n, and other factorial systems; fractional replication; simple split-plot trials; introduction to quasi-factorial and incomplete block designs; determination of optima.

521, 522. DESIGN OF SURVEYS.
(3-0) Cr. 3 each. 521: W; 522: S.
Prerequisite: 521; 401, and 448 or 541; 522: 521. Han, B.V. Sukhatme.
Comprehensive account of sampling theory as developed for use in sample surveys; simple random, stratified, systematic, cluster, and multistage sampling; methods of estimation, including ratio and regression techniques; non-sampling errors; descriptive vs. analytical surveys.

531. INDUSTRIAL STATISTICS: PROCESS CONTROL.
(EE. SSI) (3-0). Cr. 3. Alt. F. offered 1972.
Prerequisite: 343 or 448. Menzies.
Sequential analysis; continuous sampling plans; statistical process control; cost functions and Bayes procedures.

533. INDUSTRIAL STATISTICS: RELIABILITY. 
(IE. 533) (3-0) Cr. 3. Alt. F, offered 1971. 
Prerequisite: 543 or 448. Mensing. 
Probabilistic aspects of reliability models; inference for reliability parameters; design of multicomponent systems; replacement and inspection policies.

535. BIOLOGICAL STATISTICS. 
(3-0) Cr. 3. S. 
Prerequisite: 402. C.P. Cox. 
Direct and indirect biological assay; dose response curve; parallel line and slope ratio assay; crossover design; multiple assays; quantal responses; probit analysis.

536, 537. GENETIC STATISTICS. 
Prerequisite: 402, 448, Gen. 301; or Gen. 460, permission of Instructor. Pollak. 
Probability applied to genetic systems; theory of inbreeding; estimation of genetic parameters and testing of genetic hypotheses; models for quantitative inheritance; partition of genotypic variance; covariances among relatives with random mating and with selection; experimental designs for evaluating parameters; phenotypic selection for quantitative traits.

538. ECONOMETRIC STATISTICS. 
(Econ. 538) (3-0) Cr. 3. F. 
Prerequisite: 448. Fuller. 
Generalized linear regression models, dummy variables; miscellaneous estimation problems, autocorrelated errors, errors in variables, multicollinearity; estimation of parameters in simultaneous equation systems.

539. OPERATIONS RESEARCH. 
(Econ. 539, I.E. 539) (3-0) Cr. 3. W. 
Prerequisite: 543 or 448. Mensing. 
Topics in game theory, programming, and the theory of queues.

540. OPERATIONS RESEARCH METHODS AND ECONOMIC ANALYSIS. 
(Econ. 540, I.E. 540) (3-0) Cr. 3. Alt. S, offered 1972. 
Prerequisite: 446 or Math. 112, and Econ. 537 or Stat. 539. Senapata. 
Techniques of inventory control and management; other types of control, forecasting, and optimization techniques; methods of simulation and sensitivity programming and their economic applications; programming under risk in dynamic models of transportation, allocation, and replacement; dynamic and recursive programming; methods of quantitative planning of economic policy.

541, 542, 543. THEORY OF PROBABILITY AND STATISTICS. 
(3-0) Cr. 3 each. Yr. 
Prerequisite: 541: Math. 409 or 414; 542: 541, and Math. 410 or 416; 543: 542. Arnold, McClen.

COURSES FOR GRADUATE STUDENTS, major or minor

601. ADVANCED STATISTICAL METHODS. 
(3-0) Cr. 3. F. 
Prerequisite: 501, and 448 or 543. C.P. Cox. 
Principles of regression analysis; general orthogonal polynomials; multivariate analysis including Hotelling's T², the linear discriminant function and the analysis of dispersion; regression nonlinear in the parameters; seminars on special topics.

Development of distribution theory from the theory of probability; common distribution functions; derivation of sampling distributions with particular attention to normal populations; estimation by maximum likelihood; likelihood ratio tests of parametric hypotheses; introduction to general linear hypothesis theory; elements of sequential analysis; distribution free methods.

544. STATISTICAL DECISION THEORY. 
(3-0) Cr. 3. Alt. S, offered 1972. 
Prerequisite: 539, David. 
Admissibility and completeness; decision functions; Bayes and minimax solutions; sequential and nonsequential cases; utility and principles of choice.

545. STOCHASTIC PROCESSES. 
(3-0) Cr. 3. S. 
Prerequisite: 541, Arnold. 
Stationary processes with emphasis on the time domain; transformations and derived processes; normal and Poisson processes; renewal theory; Markov chains; harmonic analysis of processes.

546. NONPARAMETRIC STATISTICAL THEORY. 
(3-0) Cr. 3. S. 
Prerequisite: 542, S. Sukhatme. 
Introduction to nonparametric problems; one-sample, two-sample, and c-sample problems; order statistics and their applications; rank tests, tests for location and dispersion and their large sample properties; tests based on sample distribution functions; asymptotic relative efficiency of nonparametric tests.

549. MATHEMATICAL PROGRAMMING. 
(3-0) Cr. 3. S. 
Prerequisite: 539 or Econ. 537; one course in computer programming. Sposito.

Techniques for determining the optima of linear and nonlinear models including linear, integer, quadratic, convex, and geometric programming applied to economic, engineering, and statistical problems.

554. 555. PROBABILITY. 
(Math. 554, 555) See Mathematics.

650. STATISTICAL COMPUTATIONS ON DIGITAL COMPUTERS I. 
(Com.S. 580) (3-0) Cr. 3. W. 
Prerequisite: 402 or 448 or 542; Math. 307, Com.S. 201 or knowledge of Fortran. Kennedy. 
Programming techniques and methods for solution of problems in multiple linear regression, nonlinear regression, analysis of variance.

651. STATISTICAL COMPUTATIONS ON DIGITAL COMPUTERS II. 
(Com.S. 581) (3-0) Cr. 3. S. 
Prerequisite: 580, and Math. 409 or 414. Kennedy. 
Topics in the use of digital computers for theoretical investigations in statistics; evaluating statistical distribution functions, Monte Carlo techniques, programming symbolic operations.

580. SPECIAL TOPICS. 
Cr. var. 
A. Theory. 
B. Methods. 
C. Design of Experiments. 
D. Design of Surveys.
The surveying and mapping program is administered by the Department of Industrial Engineering in cooperation with the Department of Civil Engineering. It leads to the degree of Bachelor of Science with major in engineering operations.

This program is designed for students who desire a broadly based knowledge of surveying and mapping. Graduates of this program should find opportunities with consulting firms involved in aerial surveying and mapping, and in land surveying.

Other career opportunities exist in industry and government. Employment by industry frequently involves research, development, and testing of advanced geodetic and photogrammetric systems. Federal, state, and local government activity includes national geodetic and
mapping programs, public land surveys, natural resources exploration, control of land use, subdivision design review, and other administrative or legal control matters.

The required courses in the surveying and mapping program include all the required courses and group requirements in the engineering operations curriculum.

The following number of credits in surveying, mapping, and related courses are also required:

- Credit in surveying and mapping at the 300 level or above: 27
- Credit in civil engineering, urban planning, or engineering mechanics: 17

The 27 credits in surveying and mapping may be used to satisfy the engineering operations group requirement for sequences in an engineering area. The 17 credits in civil engineering, urban planning, or engineering mechanics must be in courses beyond those used to satisfy any of the group requirements in the regular engineering operations curriculum. Civil engineering courses used to satisfy this requirement, either in full or in part, must be in an area other than surveying.

The minimum requirement for graduation in the surveying and mapping program is 197 credit hours.

TELECOMMUNICATIVE ARTS

For description of courses, see English and Speech.

TEXTILES AND CLOTHING

Margaret C. Warning, Ph.D., Head of Department

Professors: Norma R. Hollen, M.S.; Fannie Potgieter, M.A.; Jane Saddler, M.S.; Gettel Winakor, Ph.D.

Associate Professors: Donna R. Danielson, M.S.; Ruth E. Hall, Ph.D.; Agatha L. Huepenbecker, Ph.D.


Instructors: Phyllis Brackelsberg, M.S.; Cornellia Buck, B.S.; Susan B. Occelli, B.S.; Bertha E. Seifert, M.S.

Undergraduate Study

Courses in textiles and clothing furnish knowledge and training essential to the consumer for providing clothing and household fabrics for the individual, the family, and the home. The aesthetic, economic, sociological, psychological, scientific, and cultural aspects of textiles and clothing are stressed.

The department offers work for the degree Bachelor of Science with majors in textiles and clothing, and textiles and clothing and related science. These majors, and the two options within each, provide preparation for many different kinds of positions and a basis for advanced study.

The major in textiles and clothing prepares students for careers in textiles and clothing. Option 1, design, is planned for those interested in the aesthetic aspects of textiles and clothing and in apparel or textile designing. Option 2, merchandising, prepares the student for such positions as comparison shopper, fashion stylist or coordinator, assistant buyer or buyer, merchandise manager, copywriter, fashion market reporter, director of fashion board, owner-manager of small store, director of education of sales personnel, shopping service director. Supervised work experience in a department store may be arranged.

The major in textiles and clothing and related science is designed for those who wish to
prepare for advanced study leading to careers in college teaching or in research. Option 1 enables the student to emphasize the physical sciences, thereby laying the foundation for further study and for research in textiles. Option 2, the social science option, is designed for the student interested in the economic, sociological, or psychological aspects of clothing and textiles.

Graduate Study

The department offers work for the degree Master of Science with major in textiles and clothing, and minor work to students taking major work in other departments.

Prerequisite to major graduate work is the completion of courses in applied art, chemistry (including inorganic and organic), economics, textiles and clothing (including specific courses in general textiles, clothing construction, and costume designing). Additional prerequisites may be required, depending upon the nature of the work the student wishes to pursue.

The foreign language requirement will be established at the discretion of the student's advisory committee.

Open to graduate students for minor credit only: 404, 410, 414, 429, 454, 464, 465, 490.

COURSES PRIMARILY FOR UNDERGRADUATE STUDENTS

104. TEXTILES.
   (2-3) Cr. 4. F.W.S.SSI.
   Fundamental weaves, yarn, fibers, color, and finishes with reference to selection of fabrics in relation to end use.

121. CLOTHING CONSTRUCTION.
   (0-9) Cr. 3. F.W.S.

125. PATTERN MAKING AND CLOTHING CONSTRUCTION.
   (2-7) Cr. 4. F.W.S.SSI.
   Prerequisite: Placement test-X classification or 121.
   The use of commercial basic patterns and development of foundation patterns; flat pattern designing and related garment construction; making patterns for and constructing selected dress design in appropriate fabric.

210. SOPHOMORE SEMINAR.
   (1-0) Cr. 1. F.W.S.
   Prerequisite: Sophomore or transfer standing. Orientation to textiles and clothing; professional opportunities.

225. DRAPING.
   (2-4) Cr. 4. F.W.S.SS.
   Prerequisite: 125, credit or classification in 245. Draping with emphasis on designing, fitting, and construction.

245. CLOTHING SELECTION.
   (2-3) Cr. 3. F.W.S.SSII.
   Selection of appropriate and becoming clothing for individuals, with recognition of social, economic, and design factors.

304. APPLIED TEXTILES.
   (3-0) Cr. 3. F.W.S.SSI.
   Prerequisite: 104.
   Application of basic principles of textiles in specific end uses; household textiles, clothing, nonwoven textiles; emphasis on serviceability, aesthetic, economic, and psychological aspects.

326A. 326B. CHILDREN’S CLOTHING.
   326A: (2-0) Cr. 2. F.W.S.SSI.
   326B: (0-8) Cr. 2. F.W.S.SSI.
   Prerequisite: 326B: 125 and classification in 326A.
   326A: Selection of clothing as it relates to growth and development of the child. Evaluation of ready-to-wear. 326B: Designing and construction of suitable clothing for children.

345. COSTUME DESIGN.
   (2-4) Cr. 3. F.W.S. Alt. SSI. offered 1972.
   Prerequisite: 245, A.A. 278.
   Creative problems based on source material commonly used in designing clothing.

365. TEXTILES AND CLOTHING MERCHANDISING.
   (3-0) Cr. 3. F.S.
   Prerequisite: I.A.d. 340 or Econ. 466.
   Principles of merchandising as applied to clothing, accessories, and household textiles.

401. SENIOR STUDY TOUR.
   A, B: Cr. 1; C: Cr. 1. A: F; B: S; C: Between W. and S.
   Prerequisite: Credit or classification in 414 or 454, junior or senior classification.
   Study of and visits to mills, factories, dress houses, stores, museums, and laboratories.

404. ADVANCED TEXTILES.
   (3-0) Cr. 3. F.W.S.
   Prerequisite: 304, Chem. 231, 232B.
   New developments in the textile field as reported in current literature.

410. TEXTILES AND CLOTHING DEPARTMENT SEMINAR.
   (2-0) Cr. 1. S.
   Prerequisite: Senior standing.

414. HISTORIC TEXTILES.
   (3-0) Cr. 3. F.W.S.SSI.
   Development of textiles from ancient times; a study of specific historic textiles; contemporary interpretations of historic textile designs.

429. CUSTOM TAILORING.
   (2-6) Cr. 4. F.W.S.SS.
   Prerequisite: 225.
   Custom tailoring techniques applied in making women's suits and coats.

454. HISTORY OF COSTUME.
   (3-0) Cr. 3. F.S. Alt. SSI. offered 1973.
   Prerequisite: Hist. 202.
   Styles of costume in western civilization from ancient times to the present day; cultural and economic factors associated with the development, adoption, and abandonment of styles.
COURSES FOR GRADUATE STUDENTS, major or minor

610. SEMINAR.
Cr. arr. W. Winakor.

699. RESEARCH.
UNIVERSITY STUDIES

George C. Christensen, Ph.D.
Vice President for Academic Affairs

Certain interdisciplinary courses are offered through University Studies, at the discretion of the Vice President for Academic Affairs and the University Curriculum Committee. No major is available in University Studies, but credit obtained through University Studies offerings may be applied toward a degree in any of the colleges, consistent with the stipulations of the student's curriculum.

Requests to make use of University Studies 101, 102, 103, 290, 301, 302, 303, and 490 should be directed to the Vice President for Academic Affairs and should be accompanied by a positive recommendation from the department heads and deans of the instructors making the request. The University Curriculum Committee will consider all requests and recommend to the Vice President regarding their disposition after consultation with relevant college and University committees.

The remaining University Studies courses are the responsibility of various university committees, as indicated.

COURSES PRIMARILY FOR UNDERGRADUATE STUDENTS

101, 102, 103. INTERDISCIPLINARY STUDIES.
Cr. var. Yr.
Experimental interdisciplinary courses offered by an interdepartmental group. Intended primarily for freshmen and sophomores.

111, 112, 113. FRESHMAN SEMINARS.
(2-0) Cr. 1 each. Yr.
Student-organized discussions, led by university faculty members. Subjects of current interest to be discussed in each section will be announced in advance. Offered on satisfactory-fail basis only.

290. SPECIAL TOPICS.
Cr. var.
Independent study on topics of an interdisciplinary nature. Intended primarily for freshmen and sophomores.
H. Honors Program.
I. International Studies.

301, 302, 303. INTERDISCIPLINARY STUDIES.
Cr. var. Yr.
Experimental interdisciplinary courses offered by an interdepartmental group. Intended primarily for junior and senior offerings.

321H, 322H, 323H. UNIVERSITY HONORS SEMINARS.
(2-0) Cr. 1 or 2 each time elected. Yr.
Prerequisite: Membership in the University Honors Program and permission of chairman of the University Honors Program Committee.
Interdisciplinary seminars on topics to be announced in advance. Offered on a satisfactory-fail basis only.

420. ENVIRONMENTAL STUDIES.
Cr. var.
Multidisciplinary courses sponsored by the Environmental Council that examine major environmental problem areas from a broad systems perspective.

430. SEMINAR IN INTERNATIONAL STUDIES.
(3-0) Cr. 3. F.W.S.
Prerequisite: Major in international studies. Other students may be permitted to enroll if space is available.
Seminar in international studies, sponsored by the International Studies Committee and offered by faculty from throughout the University. Intended primarily for juniors and seniors.

437. FOREIGN STUDY.
Cr. var. F.W.S.SS.
Prerequisite: Permission of chairman of the International Studies Committee.
Individual and group study in foreign countries. Intended primarily for juniors and seniors.

490. SPECIAL TOPICS.
Cr. var.
Independent study on topics of an interdisciplinary nature. Intended primarily for juniors and seniors.
H. Honors Program.
I. International Studies.

URBAN PLANNING

Thomas A. Barton, M.L.A., Professor in Charge

Professor: John R. Fitzsimmons, M.L.A.

Associate Professors: William A. Malone, M.S.; Frank W. Osgood, M.C.P.

Assistant Professors: Burl A. Parks, B.S.; Richard F. Sale, M.C.P.
Undergraduate Study

For undergraduate curriculum in Urban Planning leading to the degree Bachelor of Science, see College of Agriculture, Curricula.

The urban planner is concerned with the economic, social, and physical aspects of development of a geographic or political area. He must attain a broad comprehension of city and regional developments, their interrelationships, and the extent of their changing needs. The urban planner finds opportunities for professional service with organizations such as city, county, state, and regional planning boards and with the offices of planning consultants.

Graduate Study

The department offers work for the degree Master of Science with a major in town and regional planning. Minor work is offered to students taking major work in other departments. The degree Master of Science, major in town and regional planning, is granted upon the completion of two years of graduate study with a minimum of 60 credits in residence at Iowa State University and a total of 77 credits. Planning specializations available include:

Administration
Economic Planning
Resource Conservation
Urban Renewal
Transportation Planning

Urban Design
Human Resources Planning
Housing
Systems Analysis
State and Regional Planning

A student expecting to do major work in town and regional planning should previously have taken courses in the principles of economics, political science, sociology, statistics, computer science, urban planning, design, and graphic presentation. If a student has not previously taken a computer science undergraduate course, he will be required to study this subject as supporting work, without graduate credit, early in his graduate program. In the case of deficiencies in other areas, supporting work in those areas may also be required.

For the degree Master of Science, the foreign language requirement, if any, is established on an individual basis by the program of study committee.

Satisfactory completion of the core requirements and the acceptance of a thesis (12 credits) is required for the M.S. degree. The core requirements are:

<table>
<thead>
<tr>
<th>Planning Theory</th>
<th>6 credits (Ur.Pl. 561, 562)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Planning Techniques</td>
<td>3 credits (Ur.Pl. 571)</td>
</tr>
<tr>
<td>Background Components</td>
<td>9 credits (Econ. 461, Pol.S. 512, Soc. 410)</td>
</tr>
<tr>
<td>Planning Law</td>
<td>3 credits (Ur.Pl. 592)</td>
</tr>
<tr>
<td>Planning Studio</td>
<td>9 credits (Ur.Pl. 531, 532, 533)</td>
</tr>
<tr>
<td>Planning Research</td>
<td>3 credits (Ur.Pl. 541)</td>
</tr>
<tr>
<td>Seminars</td>
<td>4 credits (Ur.Pl. 511, 512, 513, 614)</td>
</tr>
</tbody>
</table>

In addition, the student is expected to complete 3 months of acceptable work experience in a planning office between his first and second year.

Open to graduate students for minor credit only: 372, 380, 383, 395, 431, 432, 433, 490, 492. The prerequisite of Ur.Pl. 253 is waived for graduate students in design or social science fields and may be waived for other graduate students by the instructor.

For students interested in interdisciplinary study of housing, a program is administered in cooperation with the departments of Applied Art, Architecture, Family Environment, and Landscape Architecture. For details consult the head of the department.
COURSES FOR UNDERGRADUATE STUDENTS

110. ORIENTATION IN URBAN PLANNING. (1-0) Cr. R, F.
Survey of urban planning and allied fields.

122. GRAPHIC COMMUNICATION. (L.A. 112) See Landscape Architecture.

253. SURVEY OF URBAN PLANNING. (3-0) Cr. 3. W.S.
A historical survey of planning, the nature and problems of urban areas, and the goals, procedures, and results of urban planning.

270. FORCES SHAPING OUR URBAN ENVIRONMENT. (3-0) Cr. 3. W.
Introduction to the social, political, physical, and economic forces shaping urban areas and their interrelationships. Topics include value identification and measurement; city size and form as affected by social, economic, and physical forces; land-use types, groupings and their interrelationships; and political decision making and plan implementation. (Course intended to give a comprehensive picture of planning in urban development by showing important roles other urban disciplines play in the planning process and the interrelationships of these disciplines.)

341. TRAVEL AND PRACTICE. Cr. R; F.
Field trip.

372. PLANNING ANALYSIS AND TECHNIQUES. (4-0) Cr. 4. W.
Prerequisite: 253.
An introduction to existing and emerging techniques for the preparation and criticism of plans and planning studies. Topics covered include economic, population, activity, and physical studies, and studies for the location, quantity, intensity and timing of land uses and public services. Exercises in the use of sources and techniques.

380. STATE AND REGIONAL PLANNING. (3-0) Cr. 3. F.
Prerequisite: 253 or 270.
State and regional planning, development, theories and functions, analysis techniques, and methods for guiding development and policy implementation.

383. THEORY OF THE PLANNING PROCESS. (4-0) Cr. 4. W.
Prerequisite: 253.
The nature of physical planning and its relationship to social and economic planning; levels of planning; place of planning in decision making and major decision-making groups; steps in the planning process; uses and limitation of knowledge in planning; relation of facts and values.

396. HOUSING AND URBAN RENEWAL. (3-0) Cr. 3. S.
Prerequisite: 253 or 270.
Guidelines for housing policy formulation as a part of the over-all planning process in urban areas. Includes analysis of housing needs, regulation, stimulation, renewal, and replacement of housing through public policy. The urban renewal process; analysis of various urban renewal programs; residential conservation, rehabilitation, and redevelopment; and commercial and industrial renewal.

431. REGIONAL PLANNING. (0-9) Cr. 3. F.
Prerequisite: Senior classification and permission of instructor.
Preparation of a comprehensive plan, including alternatives. Preparation of selected effectuating devices for one or more of these alternative plans.

432. URBAN DEVELOPMENT PLANNING. (0-9) Cr. 3. W.
Prerequisite: 431 or senior standing in other curricula and permission of instructor.
The programming of plans through time, by such means as community renewal programming and urban renewal projects, and planning programming-budgeting procedures.

490. SPECIAL PROBLEMS. Cr. 2 to 4.
Prerequisite: Permission of instructor.
Investigation of an approved topic commensurate with student's interest and ability. Offered only on a satisfactory-fail basis. H. Honors Program.

492. PLANNING LAW, ADMINISTRATION AND IMPLEMENTATION. (5-0) Cr. 5. F.
Prerequisite: 253.
The basis in constitutional, common, and statute law for the powers and duties of planning authorities and the powers of plan effectuation. Problems of balancing public and private interest as revealed in study of leading court cases. The administration of planning agencies and programs.

COURSES FOR GRADUATE STUDENTS, major or minor, open to qualified undergraduates

511. HISTORY AND DEVELOPMENT OF PLANNING. (2-0) Cr. 2. F.
Evolution of planning in the United States and other selected countries to relate current status and future potentials. Relates urbanization process to history and development of planning to meet local, metropolitan, regional, state, and national needs.

512. URBAN PLANNING PROFESSION. (1-0) Cr. 1. W.
Prerequisite: 511.
Various elements of public planning and the planning office, including comprehensive plan, zoning, planning commission, urban renewal, housing authority, planning administration, and other important aspects of the planning profession.

513. SEMINAR. (1-0) Cr. 1. S.
Prerequisite: 512.

531, 532, 533. URBAN AND REGIONAL PLANNING STUDIO. (0-9) Cr. 3 each. 531: S; 532: F; 533: W.
Practice in the advanced level application of existing knowledge to planning projects, with
emphasis on new towns, urban regions, comprehensive planning, and urban development programming.

541. URBAN PLANNING RESEARCH METHODS. (2-3) Cr. 3. S.
Research methods for the discovery of new knowledge in urban and regional planning. Research of various types and sources of data and information systems.

561, 562. THEORY OF URBAN PLANNING. (3-0) Cr. 3 each. 561; W; 562; S.
Prerequisite: Econ. 462 or graduate classification in town and regional planning.
561: Advanced theory of physical planning as a science. Land development models for planning purposes. Attention to the theories from which the models derive and the information systems which they require. 562: Advanced theory of physical planning as an art. Value conflicts in physical planning and arrangements, such as operational gaming, for accommodating these conflicts.

571. TECHNIQUES OF URBAN PLANNING. (3-0) Cr. 3. W.
Prerequisite: 372 or graduate classification in town and regional planning.

COURSES FOR GRADUATE STUDENTS, major or minor

614. SEMINAR. (1-0) R; S.
Prerequisite: 513.

699. RESEARCH.

VETERINARY ANATOMY

Robert Getty, D.V.M., Ph.D., Head of Department

Associate Professors: Nani G. Ghoshal, Dr.Med.Vet., Ph.D.; Bernard H. Skold, D.V.M., Ph.D.
Assistant Professors: Harpal S. Bal, B.V.Sc., M.S., Ph.D.; Jeanine Carithers, Ph.D.; Dianne Draper, Ph.D.; Donald D. Draper, Ph.D.; Daniel J. Hillmann, D.V.M.
Instructor: James R. McCoy, B.S., D.V.M.

Undergraduate Study

For undergraduate curriculum in veterinary medicine leading to the degree Doctor of Veterinary Medicine, see Veterinary Medicine, Curriculum.

Through courses in this department, veterinary students acquire a detailed knowledge of the anatomy of the domestic animals which is necessary for a proper understanding of physiology, pathology, diagnosis, surgery, and medicine.

Graduate Study

The department offers work for the degrees Master of Science and Doctor of Philosophy with major in veterinary anatomy, and minor work for students majoring in other departments. Within the veterinary anatomy major the student may specialize in microscopic anatomy and macroscopic anatomy.
Instruction and research facilities in biomedical engineering are provided jointly by the departments of Electrical Engineering, Veterinary Anatomy, and Veterinary Physiology and Pharmacology. See Biomedical Engineering for requirements.

Prerequisite to major graduate work is the completion of an undergraduate curriculum substantially equivalent to that in veterinary medicine.

Research is encouraged in gerontology, experimental neuroanatomy, advanced veterinary microscopic organology, surgical anatomy, advanced anatomy for biomedical engineering, gross anatomy, and ultrastructure of cells and tissues.

Open to graduate students for minor credit only: 401, 402, 403, 404.

### Courses Primarily for Undergraduate Students

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
<th>Prerequisite</th>
</tr>
</thead>
<tbody>
<tr>
<td>217</td>
<td>Anatomy of Domestic Animals</td>
<td>(3-6)</td>
<td>Cr. 3. F. For second year students in agriculture, and other advanced students desiring fundamental knowledge of anatomy.</td>
</tr>
<tr>
<td>301</td>
<td>Microscopic Anatomy</td>
<td>(2-8)</td>
<td>Cr. 5. F. Prerequisite: First year classification in veterinary medicine.  Cytology, basic tissues, and developmental anatomy.</td>
</tr>
<tr>
<td>302</td>
<td>Microscopic Anatomy</td>
<td>(3-8)</td>
<td>Cr. 5. W. Prerequisite: 301. The body systems and organogenesis.</td>
</tr>
<tr>
<td>303</td>
<td>Microscopic Anatomy</td>
<td>(1-10)</td>
<td>Cr. 4. S. Prerequisite: 302. The body systems, endocrines, and fetal membranes.</td>
</tr>
<tr>
<td>311</td>
<td>Gross Anatomy</td>
<td>(0-14)</td>
<td>Cr. 5. F. Prerequisite: First year classification in veterinary medicine.  Systematic and topographic study and dissection of the dog.</td>
</tr>
<tr>
<td>312</td>
<td>Gross Anatomy</td>
<td>(0-15)</td>
<td>Cr. 5. W. Prerequisite: 311. Systematic and topographic study and dissection of the horse, and comparative neurology.</td>
</tr>
<tr>
<td>313</td>
<td>Gross Anatomy</td>
<td>(0-13)</td>
<td>Cr. 5. S. Prerequisite: 312. Systematic and topographic study and dissection of the ox, sheep, pig, chicken, and laboratory animals.</td>
</tr>
<tr>
<td>401</td>
<td>Advanced Microscopic Anatomy</td>
<td>(2-8)</td>
<td>Cr. 5. F. Prerequisite: One year of college biology. Cytology, basic tissues, and developmental anatomy.</td>
</tr>
</tbody>
</table>

### Courses Primarily for Graduate Students, major or minor, open to qualified undergraduates

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
<th>Prerequisite</th>
</tr>
</thead>
<tbody>
<tr>
<td>511</td>
<td>Neuroanatomy</td>
<td>(V.Phys. 511) (2-0 or 2-6)</td>
<td>Cr. 2 or 4. Alt. W. offered 1972. Prerequisite: Permission of instructor. Getty, Ghoahal, Kitchell, Ramsey, Skold. Central and peripheral nervous system including the organs of special sense.</td>
</tr>
<tr>
<td>561</td>
<td>Comparative Mammalian Anatomy and Physiology</td>
<td>(B.M.E. 561) (3-3)</td>
<td>Cr. 4. F. Prerequisite: Credit or classification in B.&amp;B. 304 or 404. Integrated teaching approach for graduate students who have had little or no previous training in anatomy and physiology. Designed for students in animal nutrition, biochemistry, engineering, food and nutrition, psychology, and other biological sciences. Same applies to 562 and 563. Cellular structure and function, nervous system, sensory systems, and muscle systems.</td>
</tr>
</tbody>
</table>
COMPARATIVE MAMMALIAN ANATOMY AND PHYSIOLOGY.
(V.Phys. 562) (B.M.E. 562) (4-3) Cr. 5. W.
Prerequisite: Credit or classification in B.&B. 305 or 405.
Cardiovascular system, respiration, acid-base balance, and renal system.

COMPARATIVE MAMMALIAN ANATOMY AND PHYSIOLOGY.
(V.Phys. 563) (B.M.E. 563) (3-3) Cr. 4. S.
Prerequisite: B.&B. 305 or 405.
Digestion, metabolism, reproduction and endocrine systems.

SPECIAL TOPICS.
Cr. 2 to 5 each time elected.
Prerequisite: Fifteen credits of acceptable graduate work, permission of instructor.
A series of nonsequence courses selected from the following topics:
A. Ultra Structure of Animal Tissues.
B. Techniques in Electron Microscopy.
C. Gerontology of Domestic Animals.
D. Special Problems in Gross Anatomy.
E. Special Problems in Microscopic Anatomy.
F. Anatomy of Laboratory Animals. SS.
G. Anatomical Techniques. SS.

COURSES FOR GRADUATE STUDENTS, major or minor

SEMINAR.
Cr. 1. F.W.S.SS. Getty.

RESEARCH.
A. Gross Anatomy.
B. Microscopic Anatomy.

VETERINARY CLINICAL SCIENCES
Wallace M. Wass, D.V.M., Ph.D., Head of Department


Undergraduate Study

For undergraduate curriculum in veterinary medicine leading to the degree Doctor of Veterinary Medicine, see Veterinary Medicine, Curriculum.

The study of medicine and surgery summarizes and illustrates the application in practice of the training previously received in anatomy, physiology and pharmacology, pathology, and microbiology. On completion of the senior year, the student has not only the theoretical knowledge, but some of the more practical methods of applying such knowledge. The transition from the student to the practitioner presents little difficulty after such training.

The department presents course work in animal reproduction dealing with interferences with parturition, diseases of the newborn, and interferences with normal reproduction commonly termed infertility.

A systematically organized course in radiology is presented, emphasizing the handling, exposing, processing and interpreting of radiographs and the dangers of ionizing radiation to man and animal when improperly used.
Graduate Study

The department offers work for the degree Master of Science with major in Veterinary Clinical Science, and minor work for students majoring in other departments. Within the Veterinary Clinical Sciences major, the student may specialize in veterinary medicine, surgery, radiology, or reproductive diseases.

Both thesis and nonthesis options are available.

Prerequisite to major graduate work is graduation from an approved College of Veterinary Medicine.

COURSES PRIMARILY FOR UNDERGRADUATE STUDENTS

397. GENERAL SURGERY.
(6-0) Cr. 5 S.
Prerequisite: First five quarters of veterinary curriculum.
Fundamental principles of surgery.

440. RADIOLOGY.
(3-0) Cr. 3 S.
Prerequisite: First eight quarters of veterinary curriculum.
Essentials of radiology and radiobiology. Includes radiography, fluoroscopy and clinical and biological uses of X-radiation and radionuclides, with special emphasis on protection from radiation and interpretation of radiographs.

441. SPECIAL SURGERY I.
(3-0) Cr. 3 F.
Prerequisite: First two years of veterinary curriculum.
Surgical diseases of domestic animals.

442. SPECIAL SURGERY II.
(6-0) Cr. 5 W.
Prerequisite: 441.
Surgical diseases of domestic animals.

444. CLINICAL MEDICINE I.
(6-0) Cr. 6 S.
Prerequisite: First two years of veterinary curriculum.
Clinical diagnostic methods and consideration of diseases of domestic animals.

445. CLINICAL MEDICINE II.
(5-0) Cr. 5 W.
Prerequisite: 444.
Clinical diagnosis and treatment of diseases of domestic animals.

446. CLINICAL MEDICINE III.
(5-0) Cr. 5 S.
Prerequisite: 445.
Clinical diagnosis and treatment of diseases of domestic animals.

447. ANIMAL REPRODUCTION LABORATORY.
(0-3) Cr. 1 F.W.S.
Prerequisite: First two years of veterinary curriculum.

448. MEDICINE LABORATORY.
(0-3) Cr. 1 F.W.S.
Prerequisite: First two years of veterinary curriculum.

449. SURGERY LABORATORY.
(1-6) Cr. 3 F.W.S.
Prerequisite: First two years of veterinary curriculum.

450. DISTURBANCES OF REPRODUCTION.
(4-0) Cr. 4 F.
Prerequisite: First six quarters of veterinary curriculum.
General principles of diseases causing disturbances in reproduction.

490. SPECIAL PROBLEMS.
Cr. 1 to 5.
Prerequisite: Permission of department head. H. Honors Program.

491. SUMMER CLINICS.
(0-44) Cr. R; SS.
Prerequisite: First three years of the veterinary curriculum.
Introduction to clinics. Includes assignments in equine clinics, small animal clinics, veterinary field services, animal reproduction, and clinical pathology and postmortem pathology laboratories.

492, 493, 494. APPLIED VETERINARY SCIENCE.
(0-39) Cr. 13 each Yr.
Prerequisite: Fourth year classification in veterinary medicine.
Taught by all departments in the College of Veterinary Medicine. Includes clinics, clinical pathology, postmortem pathology, diagnostic laboratory, veterinary microbiology laboratory, public health laboratory, toxicology, clinical parasitology, and special laboratories in reproduction and radiology.

495, 496, 497. SEMINAR.
(2-0) Cr. 2 each. F.W.S.
Prerequisite: First three years of veterinary curriculum.
Seminars and case discussions on selected subjects by staff of the College of Veterinary Medicine and others, including student presentations. Offered on a satisfactory-fail basis only.

COURSE PRIMARILY FOR GRADUATE STUDENTS, major or minor, open to qualified undergraduates

590. SPECIAL TOPICS.
Cr. 1 to 5.
Prerequisite: Permission of instructor.
COURSES FOR GRADUATE STUDENTS, major or minor

604. **SEMINAR.**
   Cr. 1. F.W.S.

640. **ADVANCED RADIOLOGY.**
   (2-3 or 9) Cr. 3 or 5. F.W.S.
   Prerequisite: 440. Emmerson.
   Detailed principles of clinical radiology with particular reference to radiographic interpretation.

644. **ADVANCED ANIMAL REPRODUCTION.**
   Prerequisite: 440, 450. Wagner.
   Male reproduction. Will include infectious diseases affecting male fertility, and male endocrinopathies and physiologic abnormalities affecting spermatogenesis and fertility.

645. **ADVANCED ANIMAL REPRODUCTION.**
   Prerequisite: 440, 450. Wagner.
   Female reproduction. Will include postpartum physiopathology, corpus luteum function, environmental effects, and adrenal and thyroid role in reproduction. Emphasis on experimental case material and discussion of literature.

671. **ADVANCED GENERAL SURGERY.**
   (2-3 or 9) Cr. 3 or 5. F.W.S.
   Prerequisite: 442. Pearson.
   An advanced course designed to investigate and discuss the responses of the body to surgical and anesthetic procedures.

672. **ADVANCED SPECIAL SURGERY.**
   (2-3 or 9) Cr. 3 or 5. F.W.S.
   Prerequisite: 442. Pearson.
   Advanced procedures in both clinical and research techniques are offered in abdominal, thoracic, orthopedic, cardiovascular, and neurological surgery.

676. **ADVANCED MEDICINE.**
   (2-3 or 9) Cr. 3 or 5. Alt. W, offered 1972.
   Prerequisite: 446. Wass.
   Principles of general medicine. A study in depth of factors that contribute to the development of clinical signs as related to the pathogenesis of disease.

677. **ADVANCED MEDICINE.**
   (3 or 5-0) Cr. 3 or 5. Alt. S, offered 1973.
   Prerequisite: 446. Wass.
   An advanced study of metabolic diseases.

678. **LABORATORY ANIMAL MEDICINE.**
   (3 or 5-0) Cr. 3. Alt. SS, offered 1973.
   Prerequisite: 446. Flatt.
   Detailed principles of medicine and pathology of laboratory animals.

699. **RESEARCH.**

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**VETERINARY MEDICINE**

Ralph L. Kitchell, D.V.M., Ph.D., Dean
Durwood L. Baker, D.V.M., Associate Dean
Ronald E. Flatt, D.V.M., Ph.D., Associate Professor
Norman E. Hutton, D.V.M., M.S., Assistant Professor

Courses listed below are offered to undergraduate students in the College of Veterinary Medicine.

300. **PROFESSIONAL ORIENTATION.**
   (1-0) Cr. R; F.
   Prerequisite: First year classification in veterinary medicine.

490. **SPECIAL PROBLEMS.**
   Cr. 1 to 3.
   Prerequisite: Classification in veterinary medicine.
   Independent or small group study of a specific area for which no course is available in an existing department.

498. **PROFESSIONAL ORIENTATION AND JURISPRUDENCE.**
   (3-0) Cr. 3. S.
   Prerequisite: Fourth year classification in veterinary medicine.
   Professional ethics and other topics for the professional man.

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**VETERINARY MICROBIOLOGY AND PREVENTIVE MEDICINE**

R. Allen Packer, D.V.M., Ph.D., Head of Department


Assistant Professors: Patricia M. Gough, B.S., Ph.D.; Delbert L. Harris, D.V.M., Ph.D.; Loyd A. Jensen, D.V.M., M.S.

Instructors: Billy J. Edmundson, D.V.M.; Leon N.D. Potgieter, B.V.Sc., M.S.
Undergraduate Study

For undergraduate curriculum in veterinary medicine leading to the degree Doctor of Veterinary Medicine, see Veterinary Medicine, Curriculum.

The Department of Veterinary Microbiology and Preventive Medicine offers instruction in pathogenic bacteriology and mycology, animal virology, immunology, epidemiology, and public health. Regulatory and preventive veterinary medical aspects of the infectious diseases of animals are emphasized in courses for the student in the veterinary curriculum. Courses designed for students in agriculture deal with the principles of disease prevention in farm animals.

Graduate Study

The department offers work for the degree Master of Science with majors in veterinary microbiology and veterinary preventive medicine, work for the degree Doctor of Philosophy with major in veterinary microbiology, and minor work to students taking major work in other departments.

Prerequisite to major graduate work is the possession of the D.V.M. degree or the completion of an undergraduate program in biological science with emphasis in microbiology.

COURSES PRIMARILY FOR UNDERGRADUATE STUDENTS

381. GENERAL BACTERIOLOGY AND IMMUNOLOGY. (3-9) Cr. 6. F.
Prerequisite: B.&B. 304, 305.
Morphology, classification, and physiological characteristics of pathogenic bacteria; principles of infection and immunity.

382. PATHOGENIC BACTERIOLOGY. (4-6) Cr. 6. W.
Prerequisite: 381, V.Pth. 371.
Detailed study of bacteria associated with animal disease.

383. VIROLOGY AND PRINCIPLES OF EPIDEMIOLOGY. (4-4) Cr. 5. S.
Prerequisite: 381, V.Pth. 371.
Characteristics of the viruses which infect animals; mechanisms of infection and techniques used in the study of viruses. Principles of epidemiology as applied to the infectious diseases of animals.

431, 432, 433. INFECTIOUS DISEASES AND PREVENTIVE MEDICINE. (3-3) Cr. 3. W.
Prerequisite: Third year classification in veterinary curriculum.
History, etiology, epidemiology, laboratory diagnosis, regulatory control, public health and preventive medical aspects of the infectious diseases of animals.

484. PUBLIC HEALTH I. (3-0) Cr. 3. F.

COURSES PRIMARILY FOR GRADUATE STUDENTS, major or minor, open to qualified undergraduates

509. GENERAL VIROLOGY. (Bact. 509) See Bacteriology.

520. SEROLOGY. (Imblio. 520) (2-6) Cr. 4. F.
Prerequisite: 381 or Bact. 300. Kaeberle.
Principles of serology as applied to the diagnosis of infectious diseases and research in immunology.

522. PRINCIPLES OF EPIDEMIOLOGY. (3-0) Cr. 3. S.
Prerequisite: 382, 383.
Factors which influence the spread and perpetuation of animal diseases in animal and human populations.
526. **ADVANCED VETERINARY VIROLOGY.**

(3-4) Cr. 5. Alt. W, offered 1972.
Prerequisite: 383 or 509, permission of instructor. Mare.

The study of pathogenesis and ecology of viral infections and the procedures for diagnosis and control of viral diseases.

590. **SPECIAL TOPICS.**

Cr. 1 to 5.
Prerequisite: 382.

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**COURSES FOR GRADUATE STUDENTS, major or minor**

604. **SEMINAR.**

(1-0) Cr. 1. F.W.S. Packer.

625. **PATHOGENIC BACTERIOLOGY.**

(3-6) Cr. 5. 88.
Prerequisite: 381, 382. Packer.

Advanced study of the pathogenic bacteria and technical procedures used in research.

626. **BASIC MECHANISMS IN ANIMAL VIROLOGY.**

Prerequisite: 509 or 526; B.&B. 406, permission of instructor. Mare.

Advanced study of animal virus host-cell interactions and technical procedures utilized in animal virus research.

629. **MEDICAL IMMUNOLOGY.**

(Imbloc. 629) (3-6) Cr. 5. W.
Prerequisite: 520, 10 quarter credits in biochemistry, permission of instructor. Kaeberle.


699. **RESEARCH.**

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**VETERINARY PATHOLOGY**

Frank K. Ramsey, D.V.M., Ph.D., Head of Department


**Undergraduate Study**

For undergraduate curriculum in veterinary medicine leading to the degree Doctor of Veterinary Medicine, see *Veterinary Medicine, Curriculum*.

The Department of Veterinary Pathology offers a systematic study of the dynamics of the disease process. Emphasis is placed on the manner in which disease brings about alterations in the anatomical structure and chemical and physiologic activities of animal cells, tissues, organs, and body systems. The application of these studies forms the basis for more accurate diagnosis which is essential for the treatment and prevention of animal diseases.

**Graduate Study**

The department offers work for the degrees Master of Science and Doctor of Philosophy with major in veterinary pathology, and minor work for students majoring in other departments. Within the veterinary pathology major the student may specialize in veterinary parasitology and veterinary toxicology.
A satisfactory reading knowledge of one language is strongly recommended for the Master of Science degree. A satisfactory reading knowledge of two languages or a comprehensive knowledge of one language is strongly recommended for the Ph.D. degree. For students whose native language is not English, the ability to communicate adequately in English (certified by the Department of English) may be acceptable as a substitution for the reading knowledge of one foreign language. The department uses the standardized examinations provided by Educational Testing Service and administered by the University for determining the proficiency of the reading knowledge of a student in a foreign language.

It is possible to study for the degree Master of Science on a nonthesis basis. This option requires the completion of a minimum of 50 graduate credits, of which at least 15 must be earned in course work outside the department. The degree Master of Science with thesis requires the completion of a minimum of 45 graduate credits.

Prerequisite to major graduate work is the completion of an undergraduate curriculum leading to the degree Doctor of Veterinary Medicine.

Minor work is recommended in other departments of the College of Veterinary Medicine, and in bacteriology, biochemistry, cell biology, chemistry, zoology, entomology, physics, botany, genetics, psychology, or education.

### COURSES PRIMARILY FOR UNDERGRADUATE STUDENTS

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
<th>Prerequisites</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>371</td>
<td>General Pathology</td>
<td>(3-4)</td>
<td>Cr. 5. F.</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Prerequisite: V.An. 303, 313, V.Phys. 318.</td>
<td>Basic concepts of cellular and tissue response to disease.</td>
</tr>
<tr>
<td>372</td>
<td>Systemic Pathology</td>
<td>(4-4)</td>
<td>Cr. 6. S.</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Prerequisite: 371.</td>
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<tr>
<td>376, 377</td>
<td>Veterinary Parasitology</td>
<td>(3-3)</td>
<td>Cr. 4. W; (4-3) Cr. 5. S.</td>
<td></td>
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<tr>
<td></td>
<td></td>
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<td>Prerequisite: 376: 371; 377: 376.</td>
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<tr>
<td>422, 423</td>
<td>Special Pathology</td>
<td>(4-4)</td>
<td>Cr. 5. W; (2-2) Cr. 3. S.</td>
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</tbody>
</table>

### COURSES PRIMARILY FOR GRADUATE STUDENTS

#### COURSES FOR GRADUATE STUDENTS, major or minor

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<thead>
<tr>
<th>Course Code</th>
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<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Prerequisite: Permission of instructor. Getty, Ramsey.</td>
<td>Central and peripheral nervous systems including the organs of special sense.</td>
</tr>
<tr>
<td>551</td>
<td>General Pathology</td>
<td>(3-4)</td>
<td>Cr. 5. F.</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Prerequisite: V.An. 303, 313, or permission of instructor. Ramsey.</td>
<td>Fundamentals of disease with emphasis on disease in animals.</td>
</tr>
</tbody>
</table>

#### COURSES FOR GRADUATE STUDENTS, major or minor

<table>
<thead>
<tr>
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<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>554</td>
<td>Veterinary Toxicology</td>
<td>(3-0 or 4)</td>
<td>Cr. 3 or 5. S.</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Prerequisite: 371. Buck, Van Gelder.</td>
<td>Disease processes in animals caused by toxicants, differential diagnostic procedures, and identification of toxicants by laboratory tests.</td>
</tr>
<tr>
<td>557, 558</td>
<td>Veterinary Parasitology</td>
<td>(3-3)</td>
<td>Cr. 4. W; (4-3) Cr. 5. S.</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Prerequisite: 557: Permission of instructor; 558: 557. Greve, Kemp.</td>
<td>Problems of parasitism in relation to animals.</td>
</tr>
<tr>
<td>590</td>
<td>Special Topics</td>
<td>Cr. 1 to 5. F.W.S.</td>
<td>Prerequisite: 423.</td>
<td>Special topics in the field of veterinary pathology and parasitology.</td>
</tr>
</tbody>
</table>

#### COURSES FOR GRADUATE STUDENTS, major or minor

<table>
<thead>
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<tbody>
<tr>
<td>604</td>
<td>Seminar</td>
<td>Cr. 1. F.W.S.58.</td>
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<tr>
<td>653</td>
<td>Cellular Pathology</td>
<td>(3-0 or 4)</td>
<td>Cr. 3 or 5. Alt. F, offered 1973.</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Prerequisite: 511, 653. Ramsey.</td>
<td>Advanced study of diseases of the nervous system.</td>
</tr>
</tbody>
</table>
655. **PHYSIOPATHOLOGY OF THE SKELETAL SYSTEM.**  
(3-0 or 4) Cr. 3 or 5. Alt. W, offered 1973.  
Prerequisite: 653.  
An advanced study of the nutritional and infectious diseases of bones and joints of animals.

656. **ADVANCED VETERINARY PATHOLOGY.**  
(1-3 to 12) Cr. 2 to 5. F.W.S.  
Prerequisite: 373, 423.  
A. Experimental Pathology.  
B. Experimental Parasitology.  
C. Advanced Post-Mortem Techniques.  
D. Pathologic Hematology.  
E. Mycotic and Parasitic Granulomatous Diseases. Ramsey.  

657. **ADVANCED VETERINARY TOXICOLOGY.**  
(1-3 to 12) Cr. 2 to 5. Alt. F, offered 1972.  
Prerequisite: 554, 653, or permission of instructor. Buck, Van Gelder.  
Advanced study of specific toxicants as related to animal diseases, public health hazards, and the chronic effects of agricultural chemicals on animal tissues.

659. **ADVANCED VETERINARY PARASITOLOGY.**  
(1-3 to 12) Cr. 2 to 5. F.W.S.  
Prerequisite: 377, and 423, or 558. Greve, Kemp, Jeska, Zimmermann.  
Introduction to research in animal parasitology.

660. **PATHOLOGY OF PARASITIC DISEASES.**  
(2-6) Cr. 5. Alt. SS, offered 1972.  
Prerequisite: 551. Greve, Kemp, Jeska, Zimmerman.  
A study of the gross and microscopic tissue changes caused by parasites.

699. **RESEARCH.**  
A. Veterinary Pathology.  
B. Veterinary Parasitology.  
C. Veterinary Toxicology.

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**VETERINARY PHYSIOLOGY AND PHARMACOLOGY**

Melvin J. Swenson, D.V.M., Ph.D., Head of Department


*Assistant Professor: Rodney H. Ingraham, D.V.M., M.S.*

**Undergraduate Study**

For undergraduate curriculum in veterinary medicine leading to the degree Doctor of Veterinary Medicine, see *Veterinary Medicine, Curriculum.*

A thorough knowledge of basic physiology is imperative in order to understand physiologic changes encountered in metabolic and infectious diseases. In physiology courses the students make a detailed study of functions and activities of cells, tissues, organs, and systems constituting the animal body.

Pharmacology includes a systematic study of pharmacodynamics, toxicology, and clinical application of drugs. Each of these topics is given proper consideration in the courses in pharmacology with special emphasis on drugs and therapeutic practices important in Veterinary Medicine.

**Graduate Study**

The department offers work for the degrees Master of Science and Doctor of Philosophy with major in physiology (domestic animals) and minor work for students majoring in other departments.

Any foreign language acceptable to the student's advisory committee is approved for the degree Doctor of Philosophy. A grade of 500 is required on the Educational Testing Service examination to meet the requirement. There is no language requirement for the degree Master of Science.

Instruction and research facilities in biomedical engineering are provided jointly by the departments of Electrical Engineering, Veterinary Anatomy, and Veterinary Physiology and Pharmacology. See *Biomedical Engineering* for requirements.
Students expecting to do major work should have fundamental knowledge of physiology, mathematics, zoology, anatomy, physics, and chemistry.

Open to graduate students for minor credit only: 366, 367, 368, 490.

COURSES PRIMARILY FOR UNDERGRADUATE STUDENTS

284. PHYSIOLOGY OF DOMESTIC ANIMALS. (3-0) Cr. 3. W,S.
Prerequisite: V.An. 217.
For agricultural and other students who are interested in basic and applied animal physiology.

314. COMPARATIVE MAMMALIAN PHYSIOLOGY. (3-4) Cr. 4. F.
Prerequisite: Credit or classification in V.An. 301 and 311.
Physiology of body fluids, water, electrolytes, excretion, and respiration. Courses 314, 315, 316, 317, and 318 are designed for veterinary students.

315. COMPARATIVE MAMMALIAN PHYSIOLOGY. (4-4) Cr. 5. W.
Prerequisite: 314.
Physiology of the nervous system, digestion, absorption, and metabolism.

316. COMPARATIVE MAMMALIAN PHYSIOLOGY. (3-0) Cr. 3. S.
Prerequisite: 315.
Physiology of the cardiovascular system, blood, skeletal muscle, energy, and skin.

317. COMPARATIVE MAMMALIAN PHYSIOLOGY. (3-0) Cr. 3. S.
Prerequisite: 315.
Physiology of endocrines, reproduction, and lactation.

COURSES PRIMARILY FOR GRADUATE STUDENTS, major or minor, open to qualified undergraduates

504. SEMINAR. Cr. 1. W.
Prerequisite: Permission of instructor.
A student participation seminar in which graduate students present an oral and written review of an assigned topic.

Prerequisite: Permission of instructor. Engen, Getty, Swenson.
Embryology, structure, and function of endocrine organs.

512. AUTONOMIC NERVOUS SYSTEM PHYSIOLOGY. (3-3) Cr. 4. Alt. W, offered 1972.
Prerequisite: Permission of Instructor.
Cellular considerations, neurotransmission, hypothalamus, cortical control, reflex arcs, control and regulation of internal functions and visceral organs.

Prerequisite: Permission of Instructor.
Cellular considerations, neurotransmission, reflex arcs, synaptic inhibition in brain and spinal cord, electroencephalography and evoked potentials, and sleep.

518. COMPARATIVE MAMMALIAN ANATOMY AND PHYSIOLOGY. (V.An. 561) (B.M.E. 561) (3-3) Cr. 4. F.
Prerequisite: Credit or classification in B.&B. 304 or 404.
Integrated teaching approach for graduate students. An advanced introduction to specific classes of drugs. Courses 316 and 317 are taken simultaneously with courses 318 and 319.

519. COMPARATIVE MAMMALIAN PHYSIOLOGY. (1-3) Cr. 2. S.
Prerequisite: 315.
Laboratory experiments to be taught simultaneously with courses 316 and 317.

Prerequisite: 264.
Basic physiological processes in poultry with emphasis on the chicken.

367. PHARMACOLOGY AND THERAPEUTIC PRINCIPLES. (4-3) Cr. 5. F.
Prerequisite: 318.
General principles of pharmacodynamics, including measurement, administration, distribution, receptor action, and elimination of drugs. Introduction to specific classes of drugs. Courses 367 and 368 are designed for veterinary students and non-DVM graduate students minoring in physiology.

368. PHARMACOLOGY. (5-3) Cr. 5. W.
Prerequisite: 367.
Pharmacodynamics of drugs and their classes of importance in veterinary medicine.

490. SPECIAL PROBLEMS. Cr. 1 to 5 each time taken.
Prerequisite: Permission of Instructor.
H. Honors Program.
COURSES FOR GRADUATE STUDENTS, major or minor

660. DIGESTIVE PHYSIOLOGY.
(3-0) Cr. 3. Alt. S, offered 1972.
Prerequisite: Permission of instructor.
Neuromuscular characteristics of digestive tract,
digestion, absorption, microbial digestion, and
a comparative study of differences between ruminant
and simple-stomached animals.

661. EXPERIMENTAL TECHNIQUES IN
PHYSIOLOGY.
(2-4) Cr. 4. 88.
Prerequisite: 563 or Zool. 553. Hembrough, Pearson.
Study of basic physiology in animals with vari­
ous fistulas, bypasses, and extirpations pro­
duced by surgical techniques.

699. RESEARCH.

WATER RESOURCES

Advisory Committee: Don Kirkham, Ph.D., Chairman; Roger W. Bachmann, Ph.D.; E.R.
Baumann, Ph.D.; John D. Dodd, Ph.D.; Keith M. Hussey, Ph.D.; Howard P. Johnson, Ph.D.;
Mary S. Pickett, Ph.D.; John F. Timmons, Ph.D.; Homer W. Walker, Ph.D.; Henry H. Webster,
Ph.D.

Work is offered for the degrees Master of Science and Doctor of Philosophy with major
in water resources under a cooperative arrangement with various departments including Agri­
cultural Engineering, Agronomy, Bacteriology, Botany and Plant Pathology, Civil Engineering,
Earth Science, Economics, Family Environment, Food Technology, Forestry, and Zoology and
Entomology. Minor work is offered to students taking major work in other areas. Facilities
exist in several departments for fundamental research in such areas as source, distribution,
and movement of water (hydrology); hydraulics of water control facilities; physical, biological,
and chemical properties of water (water quality); and economics of water resource develop­
ment. For the nonthesis Master of Science degree, 52 quarter credits are required.

A student majoring in water resources will choose a major professor from the graduate
faculty membership of the cooperating departments and will develop his program of study
under the guidance of a committee nominated by the administrative department head, approved
by the Water Resources Advisory Committee, and appointed by the dean of the Graduate
College. For administrative purposes the student will be in the department of his major pro­
fessor.

For the degrees Master of Science and Doctor of Philosophy, the foreign language require­
ment, if any, is established on an individual basis by the program of study committee.

COURSES PRIMARILY FOR GRADUATE STUDENTS, major or minor, open to
qualified undergraduates

501. WATER RESOURCES I.
(3-0) Cr. 3. F.
Prerequisite: Permission of water resources ad­
visory committee.
Introduction to water resources planning. Hy­
drology: source, distribution, and movement of
water and hydraulics of water control facilities.

502. WATER RESOURCES II.
(3-0) Cr. 3. W.
Prerequisite: Permission of water resources ad­
visory committee.
Water resources planning. The role of quality
in water resources: physical, chemical, and bio­
logical aspects of water and waste water.

503. WATER RESOURCES III.
(3-0) Cr. 3. S.
Prerequisite: Permission of water resources ad­
visory committee.
Water resources planning. Legal, government,
eco-econonomic, administrative, and planning as­
pects of water resources.

590. SPECIAL TOPICS.
Cr. var.
Prerequisite: Permission of instructor.
Literature reviews and conferences in accordance
with needs and interests of the student.

WILDLIFE BIOLOGY

For description of courses, see Zoology and Entomology.
ZOOLOGY AND ENTOMOLOGY

Oscar E. Tauber, Ph.D., Chairman of Department


Undergraduate Study

The department offers work for the degree Bachelor of Science with majors in zoology, entomology, and fisheries and wildlife biology. For undergraduate curriculum in sciences and humanities, major in zoology, see Sciences and Humanities, Curriculum. For undergraduate curricula in agriculture, majors in entomology or in fisheries and wildlife biology, see Agriculture, Curriculum.

Majors in the department find employment as teachers and research workers, wildlife and fishery biologists, entomologists, research aides, extension specialists, and technicians in industrial laboratories, hospitals, and clinics.

The department offers courses fundamental to specialization in the various branches of zoology and biology and the teaching of biological sciences, as well as in human and veterinary medical sciences, agriculture, and home economics. The curricula are flexible and adaptable to the needs of the individual. Opportunity is given for each student to plan his program of courses so that emphasis is put on his own vocational objective.

Undergraduate preparation is offered in animal ecology, embryology, entomology, fisheries and wildlife biology, general zoology, marine zoology, parasitology, physiology, and in preprofessional programs in dentistry, medical technology, human medicine, veterinary medicine, pharmacology, physical therapy, and nursing.

Undergraduate majors in this department usually include most of the following basic courses in their programs: Biol. 101, 101A, 103, 107 (Bot. 107); Zool. 106 (Biol. 106), 303, 307, 311, 320, 322, 334, 370, 402, 455; Bact. 300. As supporting work, undergraduate majors have found the following courses desirable: Gen. 301 or 400; Chem. 141, 142, 334, 335; Psych. 101; Soc. 134; Math. 109, 110; Stat. 101; Geol. 100; Phys. 111, 112, 113; Econ. 241, 242; Engl. 201. These courses are not to be regarded as fixed requirements or as complete outlines of the work necessary for the major. They are given solely for the convenience of the students or advisers who wish to estimate the amount of basic, nonspecialized study which may be needed.

Majors in the Department of Zoology and Entomology are encouraged to take advantage of the special opportunities available in summer courses at the Iowa Lakeside Laboratory at Lake Okoboji. (See Index, Iowa Lakeside Laboratory.) Those students interested should consult with, or write to, the department chairman.

Graduate Study

The department offers work for the degrees Master of Science and Doctor of Philosophy with majors in zoology, entomology, fisheries biology, and wildlife biology, and minor work in each of these fields. Within the appropriate major, the student may specialize in animal be-
behavior, cytology, ecology, economic entomology, embryology (developmental biology), insect toxicology, limnology, medical entomology, morphology, parasitology, physiology, protozoology, and taxonomy.

Prerequisite to major and minor graduate work in the Department of Zoology and Entomology is the completion of at least two years of zoological courses, for part of which credit in other closely allied biological sciences may be substituted. Specific course requirements for advanced degrees depend partly upon previous training and experience in the major field of specialization.

Proficiency in one foreign language is required for the M.S. and Ph.D. The same language may serve for both degrees. The degree of proficiency may be demonstrated by one year of college credit with a minimal average of 2.0 (on a 4.0=A scale), by an Educational Testing Service Foreign Language Examination score of at least 500, or by committee approval of equivalent language experience. The student's committee may require additional language competence.

Major and minor work in the area of cell biology is offered under cooperative arrangement with the departments of Bacteriology, Biochemistry and Biophysics, Botany and Plant Pathology, and Genetics. For description, see Cell Biology.

Zoology and Entomology is one of the cooperating departments in the biology program and in the water resources program. See Biology and Water Resources.

Graduate programs of the fisheries and wildlife section of the department are associated with the Iowa Cooperative Fisheries Research Unit, and the Iowa Cooperative Wildlife Research Unit. The European Corn Borer Laboratory at Ankeny is available for advanced study in certain phases of entomological research. Various graduate courses in zoology are taught during the summer, and special research projects are supervised at the Iowa Lakeside Laboratory, Lake Okoboji.

Open to graduate students for minor credit only: 307, 324, 401, 402, 405, 428, 447, 448, 455, 464, 465, 470.

Index to field of work is given by the second and third figures of course numbers:
00-09 General Zoology 50-59 Physiology
10-19 Parasitology 60-69 Fisheries Biology
20-29 Anatomy 70-79 Entomology
30-39 Embryology 90-99 Problems and Research
40-49 Wildlife Biology

COURSES PRIMARILY FOR UNDERGRADUATE STUDENTS

*100. TECHNICAL LECTURE.
(1-0) Cr. R; F.
Orientation to fields of entomology and fisheries and wildlife. Required of agriculture students majoring in entomology and in fisheries and wildlife biology.

106. GENERAL ZOOLOGY.
(Biol. 106) (3-6) Cr. 5. F.W.S.SII.
Prerequisite: Biol. 101, 101A.
Selected aspects of classification, phylogeny, development, physiology, morphology, and ecology.

156. ELEMENTARY HUMAN PHYSIOLOGY AND ANATOMY.
(3-4) Cr. 5. F.W.S.SS.
Prerequisite: High school chemistry credit or credit or classification in Chem. 141 and 141L.
Basic physiology and anatomy of human organ systems.

*241. PRINCIPLES OF WILDLIFE CONSERVATION.
(3-0) Cr. 3. W.
Prerequisite: Biol. 103.
History and biological basis of fish and wildlife conservation and management.

256. HUMAN PHYSIOLOGY.
(3-3) Cr. 4. S.
Prerequisite: 155.
Functions of human organ systems.

302L. FIELD BIOLOGY.
(See list of courses offered at the Iowa Lakeside Laboratory.)

303. ANIMAL EVOLUTION.
(3-0) Cr. 3. F.W.SS.
Prerequisite: Twelve credits in biological sciences, including Zool. 106; 320 recommended. Baker, Brown, Hicks.
Origin and evolution of animal life; sources and interpretation of evidence; principles as demonstrated in the animal kingdom.

304. ANIMAL BEHAVIOR.
Prerequisite: 106, Biol. 103, Shaw.
Identification, integration, causation, development, evolution, and function of individual and group behavior patterns.
### Courses and Programs

<table>
<thead>
<tr>
<th>Course Code</th>
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<tbody>
<tr>
<td><strong>320. HERPETOLOGY</strong>&lt;br&gt;(2-3) Cr. 3 S.</td>
<td>Principles and mechanisms of embryonic development of vertebrates.</td>
<td></td>
<td>Prerequisite: 106; 320 recommended. Weller. Biology, classification, and identification of major bird groups; laboratory and field work, including one-day trips to bird habitats.</td>
</tr>
<tr>
<td><strong>321. HISTOLOGY</strong>&lt;br&gt;(2-6) Cr. 4 F.W.</td>
<td>Survey of major groups of animal parasites; biology and host-parasite relationships of parasitic protozoans, worms, arachnides, crustaceans, insects, and vertebrates.</td>
<td></td>
<td>Prerequisite: 106; 320 recommended. Ellis. Microscopic study of vertebrate tissues.</td>
</tr>
<tr>
<td><strong>322. HISTOLOGICAL TECHNIQUES</strong>&lt;br&gt;(2-6) Cr. 4 W.S.SSI.</td>
<td>Methods of fixing, sectioning, mounting, and staining tissues for microscopic study.</td>
<td></td>
<td>Prerequisite: 106; 322 recommended. Buttrey. Methods of fixing, sectioning, mounting, and staining tissues for microscopic study.</td>
</tr>
<tr>
<td><strong>325. MAMMALIAN ANATOMY</strong>&lt;br&gt;(2-6) Cr. 4 F.</td>
<td>Advanced study and dissection of cat, rabbit, or other mammal; comparisons with human anatomy. For students preparing for medicine, nursing, or related fields.</td>
<td></td>
<td>Prerequisite: Eight credits in biological sciences, including one course in zoology. Haupt. Advanced study and dissection of cat, rabbit, or other mammal; comparisons with human anatomy. For students preparing for medicine, nursing, or related fields.</td>
</tr>
<tr>
<td><strong>334. VERTEBRATE EMBRYOLOGY</strong>&lt;br&gt;(3-6) Cr. 5 F.W.S.SSI.</td>
<td>Principles of anatomy of human motion in terms of skeletal and muscular systems. For students in physical education, prenursing, and preprofessional therapy.</td>
<td></td>
<td>Prerequisite: 106 or 155. Haupt. Principles of anatomy of human motion in terms of skeletal and muscular systems. For students in physical education, prenursing, and preprofessional therapy.</td>
</tr>
<tr>
<td><strong>340. ORNITHOLOGY</strong>&lt;br&gt;(2-6) Cr. 4 S.</td>
<td>Survey of major groups of animal parasites; biology and host-parasite relationships of parasitic protozoans, worms, arachnides, crustaceans, insects, and vertebrates.</td>
<td></td>
<td>Prerequisite: 106, Biol. 103. Ulmer. Survey of major groups of animal parasites; biology and host-parasite relationships of parasitic protozoans, worms, arachnides, crustaceans, insects, and vertebrates.</td>
</tr>
<tr>
<td><strong>341. BIRD STUDY</strong>&lt;br&gt;(2-3) Cr. 3 S.</td>
<td>Survey of major groups of animal parasites; biology and host-parasite relationships of parasitic protozoans, worms, arachnides, crustaceans, insects, and vertebrates.</td>
<td></td>
<td>Prerequisite: 106; Biol. 103 recommended. Weller. Biology and identification of birds with emphasis on Iowa. Field trips. Not acceptable for credit in fisheries and wildlife biology curriculum.</td>
</tr>
<tr>
<td><strong>349. FISHERIES AND WILDLIFE SEMINAR</strong>&lt;br&gt;(2-0) Cr. 1 F.W.</td>
<td>Survey of major groups of animal parasites; biology and host-parasite relationships of parasitic protozoans, worms, arachnides, crustaceans, insects, and vertebrates.</td>
<td></td>
<td>Prerequisite: 241, junior standing. Current topics in fisheries and wildlife biology.</td>
</tr>
<tr>
<td><strong>358. HUMAN PRENATAL DEVELOPMENT</strong>&lt;br&gt;(3-3) Cr. 4 F.W.S.</td>
<td>Survey of major groups of animal parasites; biology and host-parasite relationships of parasitic protozoans, worms, arachnides, crustaceans, insects, and vertebrates.</td>
<td></td>
<td>Prerequisite: Biol. 101A or Zool. 155. Fasel. Physiological aspects of intrauterine life; maternal-fetal relationships; reproductive hormones.</td>
</tr>
<tr>
<td><strong>359. KINESIOLOGY</strong>&lt;br&gt;(3-6) Cr. 5 F.W.S.SSI.</td>
<td>Survey of major groups of animal parasites; biology and host-parasite relationships of parasitic protozoans, worms, arachnides, crustaceans, insects, and vertebrates.</td>
<td></td>
<td>Prerequisite: 106 or 155. Haupt. Anatomy of human motion in terms of skeletal and muscular systems. For students in physical education, prenursing, and preprofessional therapy.</td>
</tr>
</tbody>
</table>
COURSES PRIMARILY FOR GRADUATE qualified undergraduates

500. SEMINAR. (3-3) Cr. 1. F.W.S.
Prerequisite: Permission of instructor. Tauber. Reports of research and current literature.

Prerequisite: Fifteen credits in biology. Pedigo. Historical development of classificatory systems, with discussions concerning the species concept, phylogenetic interpretation, numerical taxonomy, and nomenclature.

503. PRIMATE EVOLUTION. (3-0) Cr. 3. S.
Prerequisite: Fifteen credits in zoology. Shaw. Relationships and developmental history of primates.

Prerequisite: Twenty credits in biological sciences. Hicks. Biology, morphology, ecology, phylogenetic relationships, and economic importance of arachnids, especially mites, ticks, and spiders.

Prerequisite: Permission of instructor; 311 recommended. Ellis. Biology of free-living and parasitic nematodes.

Prerequisite: Fifteen credits in zoology; 307 or 311 recommended. Buttry. Taxonomy, morphology, life history, ecology, genetics, biology, evolution, and identification of major groups of free-living Protozoa.

508L AQUATIC ECOLOGY. (See list of courses offered at the Iowa Lakeside Laboratory.)

510L PROTOZOOLOGY. (See list of courses offered at the Iowa Lakeside Laboratory.)

Prerequisite: Fifteen credits in zoology; 307, 311, or 305 recommended. Buttry. Taxonomy, morphology, life history, host-parasite relationships, evolution, identification, and medical significance of major groups of parasitic Protozoa.

512. HELMINTHOLOGY. (2-6) Cr. 4. F.
Prerequisite: 307, 320. Ulmer. Survey of the cestodes, trematodes, and nematodes parasitic in wildlife, laboratory animals, and man; selected vectors; identification, life histories, and host-parasite relationships. See also list of courses offered at the Iowa Lakeside Laboratory.


550. COMPARATIVE ANIMAL PHYSIOLOGY. (3-0) Cr. 5. S.
Prerequisite: 307 and 455, or permission of Instructor. Redmond. Functions in various phyla, with interpretations in terms of morphology, ecology, and evolution.

551, 552, 553. ADVANCED VERTEBRATE PHYSIOLOGY. (3-3) Cr. 4 each. 551: F; 552: W; 553: S, SIII.
Prerequisite: 320 or V.An. 404 or equivalent; 455; one quarter organic chemistry; one quarter college physics. Griffith. Primarily mammalian, systemic physiology with some cellular mechanisms. 551: Blood, nervous system, muscles. 562: Circulation, respiration, digestion. 563: Metabolism, excretion, endocrinology.

590. FISHERY ASPECTS OF WATER POLLUTION. (3-0) Cr. 3. Alt. S. offered 1973.
Prerequisite: 405, permission of instructor. Bulkley. Environmental requirements of fresh-water fish in relation to aquatic pollution.

563. FISH PROPAGATION. (2-3) Cr. 3. Alt. S. offered 1972.
Prerequisite: 465. Bulkley. Principles and techniques of fish propagation, hatchery operation, nutrition, and disease problems.

570. INSECT RESISTANCE IN CROP PLANTS. (3-0) Cr. 3. W.
Prerequisite: 370 or 376; Gen. 301. Principles and mechanisms of insect control by host plant resistance.

STUDENTS, major or minor, open to

512L HELMINTHOLOGY. (See list of courses offered at the Iowa Lakeside Laboratory.)


Prerequisite: 428 recommended. Viles. Techniques and procedures in cytological research.

538. EXPERIMENTAL EMBRYOLOGY. (3-6) Cr. 5. S.
Prerequisite: 334, organic chemistry; biochemistry and histological techniques recommended. Baker. Physiology of germ cells; parthenogenesis; marking and grafting experiments on living embryos; tissue-culture techniques.

*Courses administered by the College of Agriculture. All others administered by the College of Sciences and Humanities.
Courses and Programs

510 COURSES FOR GRADUATE STUDENTS, major or minor


572. INSECT MORPHOLOGY. (3-0) Cr. 3. W. Prerequisite: 304. Rowley. Description of the external and internal anatomy and histology of insects.


576. SYSTEMATIC ENTOMOLOGY. (3-0) Cr. 5 each. 576; W; 577: S. Prerequisite: 572. Laffoon. Classification, collection, and natural history of insects. Nomenclature and taxonomic practices. Field trips.

590. SPECIAL TOPICS. Cr. 1 to 6 each time taken. Prerequisite: Fifteen credits in zoology, permission of instructor.

Courses administered by the College of Agriculture. All others administered by the College of Sciences and Humanities.

Courses and Programs

601. ZOOLOGICAL LITERATURE. (3-0) Cr. 3. W. Prerequisite: Fifteen credits in zoology. Knight. Literature and classical authors of zoology and entomology; nomenclature; rules of zoological nomenclature.


603. POPULATION ECOLOGY. (3-0) Cr. 5. S. Prerequisite: 402. Carlander. Animal population fluctuation with emphasis on mechanics of maintaining optimal density.

604. ZOOGEOGRAPHY. (3-0) Cr. 3. Alt. W. offered 1972. Prerequisite: Fifteen credits in zoology. Lewis. Geographic distribution of animals.

605. ADVANCED LIMNOLOGY. (3-6) Cr. 5. F. Prerequisite: 405. Bachmann. Physical, chemical, and biological processes of lakes and streams and their relationships to biological productivity, ecological succession, and water quality. Limnological research techniques. Field trips.


612. ADVANCED PARASITOLOGY. (3-0) Cr. 3. S. Prerequisite: 512: 511 recommended. Ulmer. Special phases in host-parasite relationships of parasitic protozoans, worms, and arthropods.


639. SURVEY OF DEVELOPMENTAL ZOOLOGY. (3-0) Cr. 3. W. Prerequisite: 334, Gen. 301. Brown. Discussion of molecular and cytological principles of development with emphasis on recent research.


650. CELL PHYSIOLOGY. (3-0) Cr. 3. Prerequisite: 529, B.&B. 404, 405, 406. Dolphin. Physical and biological analysis of cellular activities.

654. COMPARATIVE ENDOCRINOLOGY. (3-0) Cr. 3. W. Prerequisite: 551 or 552 or 553. Griffith. Structure and function of endocrine systems of invertebrates and vertebrates.

655. INSECT PHYSIOLOGY. (3-0) Cr. 3 or 5. W. Prerequisite: 570, and 455 or 565. Mutchmor. Life processes, organ functions of insects.


663. FISHERIES RESOURCES. (3-0) Cr. 3. Alt. W. offered 1973. Prerequisite: 370, 402. Pedigo. Survey of fishery resources; analysis of problems concerned with commercial and sport fisheries and their management.

671. INSECT ECOLOGY AND POPULATION MANAGEMENT. (3-3) Cr. 4. S. Prerequisite: 370, 402; Stat. 101 or 401. Pedigo. Insect populations, emphasizing outbreaks, assessment, and concepts of management.


675. INSECT TOXICOLOGY. (3-0) Cr. 3. Alt. S. offered 1972. Prerequisite: 572, and 650 or 655. Dahm. Chemistry and mode of action of modern insecticides.


699. RESEARCH.

*Courses administered by the College of Agriculture. All others administered by the College of Sciences and Humanities.
**COURSES OFFERED AT THE IOWA LAKESIDE LABORATORY**

302L. FIELD BIOLOGY.
(4-12) Cr. 4. SSI.
Must be taken concurrently with Bot. 301L. Animals in the field, with emphasis on collection, identification, preservation, and laboratory culturing methods. May not be used as substitute prerequisite for advanced courses listing 106 as a prerequisite. Field trips.

371L. FIELD ENTOMOLOGY.
(8-24) Cr. 8. SSI.

*371L. FIELD ENTOMOLOGY.
(8-24) Cr. 8. SSI.

*Courses administered by the College of Agriculture. All others administered by the College of Sciences and Humanities.

**Permission of the instructor is a prerequisite for all courses offered at the Iowa Lakeside Laboratory.
For current information concerning courses, registration, and housing, see the annual Iowa Lakeside Laboratory Bulletin. This bulletin is usually available from participating departments after Feb. 15

490. SPECIAL PROBLEMS.
(See preceding section.)

508L, 509L. AQUATIC ECOCOLOGY.
(8-24) Cr. 8 each.
Survey of local aquatic organisms and aquatic habitats; analysis of physiographic, physical, and chemical factors. Emphasis on field work, methodology, and basic ecological principles. Field trips.

510L. PROTOZOOLOGY.
(8-24) Cr. 8. SSI.
Prerequisite: Fifteen credits in zoology; 307 or 311 recommended.
Survey of the free-living and parasitic protozoans; evolution, identification, life cycles, and host-parasite relationships.

512L. HELMINTHOCOLOGY.
(8-24) Cr. 8. SSI.
Prerequisite: 307, 320.
Survey of the cestodes, trematodes, and nematodes parasitic in wildlife, laboratory animals, and man; study of selected vectors; identification, life histories, and host-parasite relationships emphasized.

590. SPECIAL TOPICS.
(See preceding section.)

699. RESEARCH.
A technician is a specialist in the technical details of a subject or occupation. The identification of the technician as an occupational classification in industry, distinct from the learned professions, is relatively new and rapidly growing, but the work of the technician is as old as modern industry. Today the technician usually employs the proven techniques in the solution of his problems and does not concern himself with the development of new methods or techniques.

There are many technical occupations requiring varying degrees of training in a great diversity of fields. Interesting and rewarding opportunities await the student who successfully completes one of the two-year technical programs which are offered by Iowa State University. These programs include engineering technology and food service management. Each is administered by the appropriate college of the University, and graduates receive the diploma as an associate.

Students in the two-year technical programs are considered as part of the University. They assume the same obligations, receive the same privileges, and pay the same fees and tuition as other University students.

Application for admission should be made to the Director of Admissions, 104 Beardshear Hall, Iowa State University, Ames, Iowa 50010. For information about rooms, see Student Housing.
The Engineering Technology Programs

Harold B. Ellis, Ph.D., Head

Engineering technicians are persons whose work requires an understanding of physical sciences and practical mathematics so that they can apply the tried and proven methods of modern industry in the design, manufacture, and construction of products and structures or in the operation of industrial equipment and manufacturing processes. Engineering technicians perform upon their own initiative or under the general guidance of a supervising engineer; they assist the engineer and supplement his work. They are also employed in organized research activities, as members of teams with engineers and scientists wherein the engineering technicians work principally in testing and development. In many instances, engineering technicians serve in supervisory positions over manufacturing or construction operations, coordinating and directing the work of skilled craftsmen.

Engineering technicians are occupying an increasing variety of responsible positions with industry and the demand for these technically competent individuals continues to exceed the supply. With increasing industrialization and with the spreading awareness on the part of industrial managers of the capabilities of well-trained engineering technicians, this need will become greater.

There are many persons whose aptitudes, abilities, and interests qualify them for profitable, productive, and challenging careers as engineering technicians but who would find the study of engineering too abstract and theoretical. Such persons, upon graduation from one of the engineering technology programs, can expect opportunities for advancement where financial rewards are fully commensurate with their skills, talents, and willingness to assume responsibility.

Admission Requirements

To qualify for admission to an engineering technology program, a student should be a graduate of an approved high school and his credits should include one and one-half units of algebra and one unit of geometry. Other credits which are especially helpful are those in drafting, English, chemistry, physics, and trigonometry. Shop courses where students learn the use of tools are also recommended. Anyone not a graduate of an approved high school may take tests to determine his ability to benefit from the instruction, and will be considered for entrance on an individual basis. Applicants with deficiencies in third semester algebra or in geometry may remove these deficiencies by satisfactory completion of a special summer mathematics program. This special program is also recommended for those whose high school mathematics grades were below average.

Plan of Study

The two-year engineering technology programs achieve a balance between fundamental theory and the practical application of this theory as related to the various technologies.

In addition to studies in technology, the student will receive training in applied mathematics and physics which are basic to his courses in technology. He will also study English composition, with emphasis on technical exposition, oral expression, and report writing, as well as industrial organization and accounting. All of these subjects are presented with the objective of supporting his career as an engineering technician.

Work-Study Cooperative Programs

Work-study cooperative programs are offered in some instances so that the participating student may gain practical experience in engineering technology during his college career. Each work-study program is arranged so the academic phases of engineering technology are taught at the campus while actual practice is gained by working in industry during alternate quarters of the second year. The student learns and benefits from the work-study program by getting experience in his chosen technology, by being able to evaluate a particular company as a possible employer, and by receiving a reasonable financial return. The company can evaluate the student's potential as a possible future permanent employee. The University gains by the industrial experience that the participating student brings to the classroom.
The general aspects of these cooperative programs and the regulations under which they are carried on are the same as those pertaining to other cooperative programs in the College of Engineering. See Engineering Curricula, Cooperative Work-Study Programs.

Continuing Education - Bachelor of Science Preparation

Opportunities are available in the College of Engineering for a student who has graduated in the upper half of his class from an engineering technology program accredited by the Engineers' Council for Professional Development to work toward a bachelor's degree. The detailed planning of a suitable program for each student is made in consultation with his adviser and with the approval of the head of the department in which he wishes to study for his bachelor's degree. For graduation, the student must fulfill all of the normal requirements of the bachelor's program. Part of the credits may be earned through advanced standing examinations. The student's baccalaureate program will usually require an additional three years to complete.

*All engineering technology curricula at Iowa State University are accredited by the Engineers' Council for Professional Development.

Chemical Industries Technology

Leading to the diploma Associate in Applied Science. Total credits required—100.

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<th>WINTER QUARTER</th>
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|                        |              |                |                |
| Second Year            |              |                |                |
| Basic Chemical Industries | 3            | 3              | 3              |
| C. I. Tch. 51          | 4            | 4              | 4              |
| DC and AC Machines     | 2            | 2              | 2              |
| E. Tch. 71             | 2            | 2              | 2              |
| Graphical Mathematics  |              |                |                |
| A. Gr. 47              | 3            | 3              | 3              |
| Quantitative Analysis  |              |                |                |
| Chem. 60               | 4            | 4              | 4              |
| Unit Operations I      | 17           | 16             | 17             |
| C. I. Tch. 61          |              |                |                |
| English Composition    | 3            | 3              | 3              |
| Engl. 21               | 4            | 4              | 4              |
| Measurements and Instrumentation E. Tch. 72 | 2 | 2 | 2 |
| Survey of Accounting   | 3            | 3              | 3              |
| I. Ad. 75              | 4            | 4              | 4              |
| Instrumental Analysis  | 3            | 3              | 3              |
| Chem. 61               | 4            | 4              | 4              |
| Unit Operations II     | 17           | 16             | 17             |
| C. I. Tch. 62          |              |                |                |
| Letter and Report Writing | 4            | 4              | 4              |
| Eng. 40A               | 3            | 3              | 3              |
| Process Control I      | 2            | 2              | 2              |
| C. I. Tch. 72          | 3            | 3              | 3              |
| Public Speaking        | 4            | 4              | 4              |
| Sp. 30                 | 3            | 3              | 3              |
| Process Layout         | 3            | 3              | 3              |
| C. I. Tch. 80          | 4            | 4              | 4              |
| Unit Operations III    |              |                |                |
| C. I. Tch. 63          | 4            | 4              | 4              |
## Construction Technology

Leading to the diploma Associate in Applied Science. Total credits required—105.

### FALL QUARTER

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<tr>
<td>English Composition</td>
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<td>Applied Mathematics I</td>
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<td>Applied Physics I</td>
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<td>Technical Problems I</td>
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<td>Construction Drawing</td>
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<td>Library Instruction</td>
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### WINTER QUARTER

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<td>Engineering Technology Orientation</td>
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<tr>
<td>English Composition</td>
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<td>Applied Mathematics II</td>
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<td>Applied Physics II</td>
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<td>Structural and Building Drawing</td>
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### SPRING QUARTER

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<tr>
<td>Engineering Technology Orientation</td>
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<tr>
<td>Introductory Mechanics</td>
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<td>Applied Mathematics III</td>
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<td>Elementary Surveying</td>
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### Second Year

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<td>C Tch 81</td>
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<tr>
<td>Land Surveying I</td>
<td>C Tch 87</td>
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<tr>
<td>Highway and Municipal Drawing</td>
<td>C Tch 83</td>
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<td>Strength of Materials</td>
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<td>Soils Technology I</td>
<td>C Tch 90</td>
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<td>Structural Design I</td>
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<td>Properties of Materials</td>
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<td>Letter and Report Writing</td>
<td>Engl 40A</td>
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<td>Hydraulics</td>
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¹Choose two from department approved electives C.Tch 86, 88, 91, 93, 94, 95
# Electronics Technology

Leading to the diploma Associate in Applied Science. Total credits required—106.

<table>
<thead>
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<td>Technical Problems I</td>
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| **Second Year** |                |                |
| **Credits**  | **Credits** | **Credits** |
| Semiconductor Devices and Circuits E.Tch. 93 | Semiconductor Devices and Circuits E.Tch. 95 | Semiconductor Devices and Circuits E.Tch. 95 |
| 3 | 3 | 3 |
| Electronics Laboratory E.Tch. 63 | Electronics Laboratory E.Tch. 65 | Electronics Laboratory E.Tch. 65 |
| 1 | 1 | 1 |
| Systems Analysis E.Tch. 96 | Electronic Systems E.Tch. 97 | Technical Design E.Tch. 84 |
| 4 | 4 | 4 |
| Microwave Fundamentals E.Tch. 92 | Digital Computers E.Tch. 90 | Special Topics E.Tch. 99 |
| 4 | 4 | 4 |
| Letter and Report Writing Engl. 40A | Electronics Drawing II A Gr. 44 | Public Speaking Sp. 30 |
| 3 | 2 | 2 |
| Electronics Shop E.Tch. 83 | Survey of Accounting I.Ad. 75 | Introduction to Business and Industrial Organization I.Ad. 99 |
| 3 | 3 | 3 |
| Library Instruction Lib. 102 | Library Instruction Lib. 102 | Library Instruction Lib. 102 |
| R | R | R |
| **Total** | **18** | **17** | **18** |
# Mechanical Technology

Leading to the diploma Associate in Applied Science. Total credits required—106.

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## The Food Service Management Program

Thomas E. Walsh, M.A., Program Chairman

The food service management program offers an opportunity to persons desiring preparation for middle-management career positions in food service. These include positions such as food service managers or assistant managers in restaurants, hotels, motels, industrial plants, department stores, social clubs, schools, colleges and universities, and other institutions. Positions offering supervisory responsibilities and challenges within a single food service organiz-
Courses and Programs

Courses and programs are also available, as are sales positions with manufacturers and dealers of food, equipment, and other food service supplies. The technical program also provides preparation for an individual who is considering having his own restaurant or food service business.

The demand for well-trained food service technicians will continue to grow, both in Iowa and across the nation. Reasons for the growing demand include population increases, greater emphasis on tourism, increasing business competition causing more travel and entertainment by executives and salesmen, an increasing number of married women in the labor market, greater leisure time, and increasing use of food service facilities in industrial plants, schools, colleges and universities, hospitals, and government institutions.

In addition to the technical aspects of food production and service, the food service management program emphasizes business management and includes some orientation to understanding people and the factors which influence behavior. Approved on-the-job work experience during the summer between the first and second years is required. Many of the courses, such as textiles, art principles, nutrition, and special seminar topics, contribute both to on-the-job competencies of the food service technician and to effectiveness as a family member and as a citizen.

One purpose of the food service management program is to establish standards and guidelines for food service education in Iowa with the realization that additional technical education programs are being planned or considered in some community colleges. As a result, enrollment in this program is limited to a maximum of 20 new students each year.

Admission Requirements

To qualify for admission to the food service management program a student normally must be a graduate of an approved high school. High school credits in algebra, English, bookkeeping, and chemistry are recommended. Those who have not been graduated from an approved high school and who wish to make application for admission will be considered on an individual basis after completing certain tests and entrance examinations.

Food Service Management

Leading to the diploma Associate in Food Service Management. Total credits required—100.

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COURSE DESCRIPTIONS

A description of each course is contained on the following pages.

The value of each course is stated in quarter credits. A one-credit course requires one recitation involving two hours of preparation, one three-hour laboratory period, or other combination of teacher-student contact and outside preparation involving a total of three clock hours per week for 11 weeks. "Cr. R" indicates that the course is required but no credit is given.

After the title of each course are two numbers in parentheses. The first indicates the number of lectures and recitations a week and the second the number of hours of laboratory a week. For example, a course title followed by (1-3) is a course with one lecture or one recitation and three hours of laboratory a week.

At the end of the first line of each course description will be found one or more of the following letters: F.W.S.S.S. indicating which of the four quarters—fall, winter, spring, summer session—of the academic year the course is offered.

Applied Art
30. BASIC ART PRINCIPLES. (2-6) Cr. 4. W.
Principles of color and design with emphasis on application to small commercial enterprises related to the food and housing industry.

Applied Graphics
40. TECHNICAL DRAWING. (1-6) Cr. 3. F.W.SS.
Lettering, freehand sketching, use of scales and drawing instruments, theory of orthographic projection and pictorial drawing. Geometry of bearing, slope, true length, and true size. Standards for sections, symbols, and basic size specifications.

41. ELECTRONICS DRAWING I. (0-6) Cr. 2. W.S.
Lettering, freehand sketching, theory of orthographic projection of points, lines, planes, and solids. Standards for sections, dimensioning, basic fasteners, and reproduction of drawings.

44. ELECTRONICS DRAWING II. (0-6) Cr. 2. W.S.S.
Prerequisite: 41, credit or classification in E.Tech. 89.
Applications of the principles of technical drawing and development of skills in producing drawings of electronic circuits and equipment. Discussion of standard symbols and nomenclature, and short cuts in describing complex wiring layouts. Empirical equations derived from plots constructed from text data. Alignment charts. Practice in producing circuit diagrams for formal presentation.

45. TECHNICAL GEOMETRY. (1-6) Cr. 3. W.SS.
Prerequisite: 40.
Graphical solutions for geometrical problems encountered in layout and design. Clearance problems, dihedral angles, intersection of lines and planes with other planes, curved and warped surfaces.

46. MECHANICAL DETAILING. (1-6) Cr. 3. S.S.S.
Prerequisite: 40.
Preparation of production drawings to be supplied to the shop or to be used wherever a product is manufactured, fabricated, or erected. Specifications of size, shape, material, and manufacture. Standard fastener specifications, including threads, welds, rivets, keys, splines and springs. Allowance specifications for mating parts and standards of surface quality. Graphic illustration for interpretation and presentation.

47. GRAPHICAL MATHEMATICS. (0-6) Cr. 2. F.S.88.
Prerequisite: 40, credit or classification in Math. 52.
Applied Mechanics

30. INTRODUCTORY MECHANICS.
(4-0) Cr. 4. F.S.
Prerequisite: Phys. 71, credit or classification in Math. 52.
Analysis of forces acting in and upon structures. Reactions of structures and supporting bodies to applied loads. Friction. Geometrical properties, including moment of inertia, of shapes used in structural design.

31. PROPERTIES OF MATERIALS.
(2-3) Cr. 3. W.S.
Prerequisite: Credit or classification in 32.
Study of general physical properties of materials such as modulus of elasticity, yield point, ultimate strength, and endurance limit. Specific physical properties of the ferrous metals, aluminum alloys, other metals, wood, and clay products. Laboratory tests to verify analytical expressions. Stress and load carrying capacities of beams, circular shafts in torsion and columns.

32. STRENGTH OF MATERIALS.
(4-0) Cr. 4. F.W.SS.
Prerequisite: 30.
Elements of stress analysis as applied to axially loaded members, riveted and welded joints, beams, circular shafts, helical springs and columns when subjected to static, repeated or impact loading.

HYDRAULICS.
(3-3) Cr. 4. S.SS.
Prerequisite: 30.
Study of hydraulic pressure, flow of water in a pressure conduit system, open channel flow, weirs, venturi meters and a brief study of hydrology.

34. CONCRETE.
(2-6) Cr. 4. W.S.
Prerequisite: Credit or classification in 31.
Study of the types of cement, concrete aggregates, theory of mix designs and the effect of curing on the strength of concrete.

Chemistry

30, 31. FUNDAMENTALS OF GENERAL CHEMISTRY.
(2-6) Cr. 4 each; 30: F; 31: W.
Prerequisite: 31: 30.
Principles of general chemistry; properties and identification of metallic and nonmetallic elements.

32. FUNDAMENTALS OF ORGANIC CHEMISTRY.
(2-6) Cr. 4. S.
Prerequisite: 31.
Principles of organic chemistry; aliphatic, and olefin compounds, functional groups, polymers.

60. QUANTITATIVE ANALYSIS.
(2-6) Cr. 4. F.
Prerequisite: 31.
Elementary theory and practice of gravimetric and volumetric analysis.

61. INSTRUMENTAL ANALYSIS.
(2-6) Cr. 4. W.
Prerequisite: 60.
Basic principles of construction, operation, and uses of instruments in analytical chemistry.

70. INDUSTRIAL CHEMISTRY.
(2-6) Cr. 4. S.
General chemical properties of materials as applied to manufacturing and engineering uses.

Chemical Industries Technology

10. INDUSTRIAL STOICHIOMETRY I.
(0-6) Cr. 3. W.
Prerequisite: Credit or classification in Chem.
Engineering units, systems of measurement, introduction to industrial stoichiometry.

11. INDUSTRIAL STOICHIOMETRY II.
(3-0) Cr. 3. S.
Prerequisite: 10; credit or classification in Chem. 31, Math. 51, and Phys. 72.
Applications of thermodynamic data, material, and energy balances to industrial chemical problems.

51. BASIC CHEMICAL INDUSTRIES.
(3-0) Cr. 3. F.
Prerequisite: Chem. 32.
History, economics, raw materials, manufacturing processes and products of selected chemical industries. Emphasis on the petrochemical, fertilizer, gypsum, pharmaceutical, plastic, rubber, corn milling and oil seed extraction industries of Iowa.

61. UNIT OPERATIONS OF THE CHEMICAL INDUSTRIES I.
(2-6) Cr. 4. F.
Prerequisite: 11, Math. 52.
Principles of fluid flow, pipe-fitting practice, pump characteristics and over-pressure safety devices. Principles of solids, handling systems, storage, conveying, and fluidization. Application of crushing, grinding, and size separation equipment.

62. UNIT OPERATIONS OF THE CHEMICAL INDUSTRIES II.
(2-6) Cr. 4. W.
Prerequisite: 61.
Applications of filters, centrifugals, flotation, and cyclones. Principles of heat transfer applied to heat exchangers, evaporators, and dryers.

63. UNIT OPERATIONS OF THE CHEMICAL INDUSTRIES III.
(2-6) Cr. 4. S.
Prerequisite: 62.
Physical chemical separation operations including absorption, distillation, extraction, and crystallization.

72. PROCESS CONTROL IN THE CHEMICAL INDUSTRIES I.
(2-6) Cr. 4. S.
Prerequisite: 62, credit or classification in E. Tch. 72.
Principles of operation for flow, temperature, pressure, force controllers in chemical process systems. Interconnection of pneumatic-electrical systems. Introduction to frequency response and system analysis.

80. PROCESS LAYOUT IN THE CHEMICAL INDUSTRIES.
(6-9) Cr. 3. S.
Prerequisite: 51, credit or classification in 63 and 72.
Materials of construction; design and layout of chemical manufacturing processes; estimation of capital and production costs.

Construction Technology

77. CONSTRUCTION DRAWING.
(6-9) Cr. 3. F.W.
Introduction to drawing techniques applicable to the construction industry; development of proficiency in drafting, lettering, and layout.

80. ELEMENTARY SURVEYING.
(2-9) Cr. 5. S.
Prerequisite: 77, credit or classification in Math. 51.
Principles and theory of surveying. Care and use of surveying equipment. Chaining, differential and profile leveling, traversing, errors of closure, computation of areas, stadia and its application to topographic mapping.
81. HIGHWAY AND MUNICIPAL DRAWING. (2-9) Cr. 5. F.SS.
Prerequisite: 80, Math. 51.
Theory and field practice in circular, spiral, and vertical curves. Field and office work in
volved in computation of earth quantities. Setting
line and grade stakes used in the construction
of engineering projects.

82. STRUCTURAL AND BUILDING DRAWING. (2-9) Cr. 5. W.
Prerequisite: 77 or A.Gr. 40.
Preparation of shop drawings from plans for
buildings and structures. Detailing of structural
members including floor systems, beams, col-
umns, retaining walls and footings.

83. HIGHWAY AND MUNICIPAL DRAWING. (2-6) Cr. 4. F.SS.
Prerequisite: Credit or classification in 81 and
87.
Preparation of plan and profile drawings for
highways, municipal street improvements, drain-
age ditches, transmission lines, and various types
of pipe lines. Drafting work connected with
highways, municipal street Improvements,
and route construction work.

85. CONSTRUCTION METHODS (STRUCTURES). (2-3) Cr. 3. S.
Prerequisite: 82.
Study of the various methods of construction of
steel, timber, and concrete structures including bridges, buildings, footings, retaining walls, tanks, and
towers. Forming and finishing of concrete, masonry
work, paints, and wood finishes. Quantity
take-off for estimating purposes.

86. CONSTRUCTION METHODS (HIGHWAYS). (2-3) Cr. 3. S.SS.
Prerequisite: 83.
Study of the various types of equipment used in
earth moving. Methods of excavation, compac-
tion of fills, clearing, and other operations re-
lated to earth moving. Use of explosives, pile
driving, sheet piling, and construction of bases
and wearing surfaces for highways and airports.
Study of the construction industry and the or-
ganization and operation of construction com-
panies and consulting engineers.

87. LAND SURVEYING I. (2-9) Cr. 5. F.SS.
Prerequisite: 80, Math. 51.
Study of the general instructions for the sub-
division of public land in the United States.
Resurveys including apportionment of excess and
deficiency in rural and urban surveys; the legal
aspects of boundaries as they affect the land
surveyor. Plotting of new subdivisions. De-
termination of meridian by astronomical obser-
vations.

88. LAND SURVEYING II. (3-0) Cr. 3. S.SS.
Prerequisite: 87.
Legal aspects of land surveying. Case studies in
boundary litigation, preparation of legal de-
scriptions. Planning, zoning, and subdivision or-
dinances.

90. SOILS TECHNOLOGY I. (1-6) Cr. 3. W.S.
Prerequisite: A.M. 30.
Study of the origin, structure, identification, and
classification of soils as used for engineering
purposes. Soil moisture relationship, soil stabil-
ization, soil construction control and inspection.

91. SOILS TECHNOLOGY II. (2-3) Cr. 3. S.SS.
Prerequisite: Math. 52.
Introduction to soil mechanics, bearing capacity,
slope stability and pressure on retaining walls
and underground conduits.

92. STRUCTURAL DESIGN I. (2-9) Cr. 5. W.S.
Prerequisite: 82, A.M. 32, credit or classification
in A.M. 31.
Theory and design of steel and timber struc-
tures, including beam design, connections,
trusses, columns, and footings.

93. STRUCTURAL DESIGN II. (1-6) Cr. 3. S.SS.
Prerequisite: 92, A.M. 34.
Theory and design of reinforced concrete struc-
tures, including beam and column design.

94. PHOTOGRAMMETRY. (1-6) Cr. 3. S.SS.
Prerequisite: 83, Math. 52.
Mapping by use of aerial photographs. Inter-
pretation of aerial photographs for surveying
and drainage.

95. PAVING MATERIALS. (1-6) Cr. 3. S.SS.
Prerequisite: Second year classification.
Survey of current practice in selecting paving
materials; properties and testing of bituminous
materials, mineral aggregates and paving mix-
tures; quality control methods.

Economics

31. ECONOMICS OF BUSINESS. (4-0) Cr. 4. S.
The free-enterprise system and price-making
forces which regulate supply and demand, dimin-
ishing returns, substitution, opportunity costs
and monetary costs and returns.

Electronics Technology

58, 57. ELECTRIC CIRCUITS LABORATORY. (0-2) Cr. 1 each. 58: W.S.; 57: S.SS.
Prerequisite: 58; Credit or classification in 86;
57: 56, credit or classification in 87.
Laboratory investigation of DC and AC circuit

59, 63, 64, 65. ELECTRONICS LABORATORY. (0-2) Cr. 1 each. 59: S.SS; 63: F; 64: W; 65: S.
Prerequisite: 59: Credit or classification in 89;
63: 57, 59, 87, 89, credit or classification in 93;
64: 63, credit or classification in 94; 65: 64,
credit or classification in 95.
Laboratory testing, measuring, and reporting on
electronic devices and circuits.

71. DC AND AC MACHINES. (3-3) Cr. 4. F.W.SS.
Prerequisite: 87 or Phys. 72.
Performance characteristics of DC and AC ma-
chines.

72. MEASUREMENTS AND INSTRUMENTATION. (1-2) Cr. 2. W.S.
Prerequisite: Therm. or Phys. 72.
Measurement of physical characteristics. Trans-
ducers, indicators, recorders, controllers, actu-
tors, and industrial electronics.

80, 83. ELECTRONICS SHOP. (0: (1-3) Cr. 2. W.S; 83: (1-6) Cr. 3. F.
Prerequisite: 80: Phys. 72 or credit or classification
in 58; 83: 57, 59, 87, 89.
Electronics devices and circuits in operational
equipment. Shop techniques and tools applied
to the construction and testing of electronics
equipment.

84. TECHNICAL DESIGN. (1-9) Cr. 4. S.SS.
Prerequisite: Eng. 40, permission of instructor.
Application of design principles to a selected
technical project. Laboratory experience in de-
signing and constructing an item of electronic
equipment. A written technical report and period-
ical oral progress reports are required.
85, 86, 87. ELECTRIC CIRCUITS.
85: (2-2) Cr. 3. F.W; 86: (4-0) Cr. 4. W.S; 87: (3-0) Cr. 3. S.SS.
Prerequisite: Credit or classification in Math. 50 and G.Tch. 14; 86: 86, credit or classification in 56 and Math. 51; 87: 86, credit or classification in 57 and Math. 52.
Basic concepts of current and voltage, DC circuit analysis, magnetic circuits, transient behavior, basic measuring devices, and AC circuits.

89. BASIC ELECTRONICS.
(3-4) Cr. 3. S.SS.
Prerequisite: 80, credit or classification in 59 and 87.
Basic theory of transistors and vacuum tubes, practical bias and amplifier circuits.

90. DIGITAL COMPUTERS.
(3-2) Cr. 4. W.SS.
Prerequisite: 57, 59, 87, 89.

92. MICROWAVE FUNDAMENTALS.
(3-2) Cr. 4. F.SS.
Prerequisite: Credit or classification in 87, Math. 52.
Basic principles of high frequency electromagnetic wave propagation and transmission lines. Laboratory experience in high-frequency measurements.

93, 94, 95. SEMICONDUCTOR DEVICES AND CIRCUITS.
(3-0) Cr. 3 each. 93: F; 94: W; 95: S.
Prerequisite: 93: 57, 59, 87, 89, credit or classification in 63; 94: 57, 59, 87, 89, credit or classification in 64; 95: 94, credit or classification in 65.
Semiconductor devices and components. Linear integrated circuits. Function, analysis, and design of semiconductor circuits.

96. SYSTEMS ANALYSIS.
(3-2) Cr. 4. F.
Prerequisite: 57, 59, 87, 89.
Transient behavior of open and closed loop systems. Analog computer simulation. Frequency characteristics of systems and servomechanisms.

97. ELECTRONIC SYSTEMS.
(3-2) Cr. 4. W.
Prerequisite: 96.
Performance and function of electronic circuits in operational electronic systems.

99. SPECIAL TOPICS.
(3-2) Cr. 4 each time taken.
Prerequisite: Permission of Instructor.

English

20. 21. ENGLISH COMPOSITION.
(3-0) Cr. 3 each. 20: F.W; 21: W.S.
Prerequisite: 21. 20.
Principles of written composition, including grammar, mechanics, punctuation, vocabulary, and sentence structure. Practice in expository writing.

40A. 40B. LETTER AND REPORT WRITING.
(3-0) Cr. 3 each. 40A: F.W.SS; 40B: S.
Prerequisite: 21.
40A: For students in the Engineering Technology Programs. Discussion of form and layout of formal pieces of writing. Practice in formal presentation of material from technical projects. 40B: For students in the Technical Agriculture and Food Service Management Programs. Business correspondence and short reports, with emphasis on letter writing.

Food and Nutrition

31, 32. FOOD PREPARATION.
(2-6) Cr. 4 each. 31: W; 32: S.
Basic processes related to food preparation; factors relating to quality of food products.

33. APPLIED NUTRITION.
(4-0) Cr. 4. F.
Factors influencing daily food needs, habits, and preferences. Guides for selection and use of food.

General Technology

10. 11, 12. ENGINEERING TECHNOLOGY ORIENTATION.
(1-0) Cr. R each. 10: F; 11: W; 12: S.
10: Lectures to aid the first-year engineering technology student to adjust himself to his studies and campus life. 11: Basic considerations in career planning and position selection in engineering technology. 12: Inspection trips to nearby industrial plants and seminars to learn of engineering technician work in the student's chosen field of study.

14. TECHNICAL PROBLEMS I.
(0-4) Cr. 2. F.W.
Prerequisite: Credit or classification in Math. 56.

15. TECHNICAL PROBLEMS II.
(0-3) Cr. 1. W.S.
Prerequisite: 14, credit or classification in Math. 51.
Importance of precision in mathematical work. Graphs and curve fitting. Practical application of trigonometric functions.

16. TECHNICAL PROBLEMS III.
(0-3) Cr. 1. S.SS.
Prerequisite: 14, credit or classification in Math. 51.
Digital computer programming techniques applied to engineering problem solutions.

51. 52, 53. COOPERATIVE WORK-STUDY.
Required of all cooperative students in engineering technology.
Prerequisite: Permission of department head.
51: First work period in a regularly established work-study cooperative program. 52: Second work period. 53: Third work period. Students must register for these courses prior to commencing each work period.

99. SPECIAL TOPICS.
Cr. 1 to 5 each time taken.
Special topics in engineering technology.

Industrial Administration

50. ACCOUNTING IN BUSINESS.
(5-0) Cr. 5. S.
Introduction to the relationship between the activities in accounting and the operational planning and control activities in a business.

75. SURVEY OF ACCOUNTING.
(5-0) Cr. 3. F.W.SS.
A survey of the purposes and procedures of general accounting; introductory survey of cost accounting objectives and procedures.

99. INTRODUCTION TO BUSINESS AND INDUSTRIAL ORGANIZATION.
(3-0) Cr. 3. F.W.
An introduction to the broad field of business and industry; its organization, functions, and administration.
Institution Management

21. ORIENTATION TO FOOD SERVICE MANAGEMENT.
   (1-0) Cr. R; F.
   Orientation of new students to Iowa State University. Relationship of educational program to food service industry.

22. FOOD SERVICE SANITATION.
   (1-0) Cr. 1. W.
   Standards of sanitation for institution food services.

23. ORIENTATION TO SUMMER WORK EXPERIENCE.
   (1-0) First 5 weeks. Cr. R; S.
   Purpose of summer experience; arranging for employment; reporting of experience.

61. INTRODUCTION TO QUANTITY FOOD PREPARATION.
   (2-6) Cr. 4. F.
   Prerequisite: F. & N. 32.
   Basic food preparation principles and large quantity food production procedures.

62. QUANTITY FOOD PRODUCTION PROCEDURES.
   (1-9) Cr. 4. W.
   Prerequisite: 61.
   Food production, service, and related activities. Supervised laboratory experience in an established food service operation.

63. MANAGEMENT ASPECTS OF QUANTITY FOOD PRODUCTION.
   (2-6) Cr. 4. S.
   Prerequisite: 62.
   Application of management functions in quantity food production and service.

83. SALES PROMOTION AND PUBLIC RELATIONS.
   (4-0) Cr. 4. S.
   Prerequisite: Psych. 50, Soc. 35.
   Introduction to market analysis, sales promotion, and public relations. Emphasis on food service organizations.

84. PURCHASING FOOD PRODUCTS.
   (3-3) Cr. 4. F.
   Prerequisite: F. & N. 32.
   Food purchasing procedures; factors considered in preparing specifications; food storage. Field trip required.

85. FOOD SERVICE FACILITIES PLANNING AND EQUIPMENT.
   (3-3) Cr. 4. F.
   Prerequisite: 23, credit or classification in 61.
   Functions and relationships of food production and service areas; emphasis on selection and arrangement of equipment. Field trips required.

87. FINANCIAL CONTROL.
   (4-0) Cr. 4. W.
   Prerequisite: 61, I.Ad. 50.
   Budgeting, interpretation of financial statements, internal control of various costs for food service institutions.

88. PERSONNEL PROCEEDURES.
   (4-0) Cr. 4. S.
   Prerequisite: Psych. 50, Soc. 35.
   Orientation to job analysis procedures; employment practices; supervision; employer-employee relations; union and government relations.

89. BUILDING MAINTENANCE MANAGEMENT.
   (2-4) Cr. 4. W.
   Prerequisite: 65, T.&C. 40.
   Considerations in selection of building materials and furnishings. Building maintenance procedures and equipment. Field trips required.

90. SPECIAL PROBLEMS.
   Cr. var. F.W.B.S.S.
   Prerequisite: Permission of instructor.

A. Food Production.
B. Management Technology.
C. General.

91, 92, 93. SEMINAR.
   (1-0) Cr. 1 each. 91: F; 92: W; 93: S.
   Prerequisite: 92: 91; 93: 92.
   Consideration of personal qualifications in relation to personal and vocational goals; trends and issues in industry.

Library

102. LIBRARY INSTRUCTION.
   Cr. R. 5 weeks. F.W.S.
   Use of libraries and books.

Mathematics

36. HIGH SCHOOL GEOMETRY.
   Noncredit course. 58.
   Elements of Euclidean geometry including congruence, parallel lines, circles, similar polygons, coordinates and areas, surface areas and volumes. This course may be used to satisfy the geometry prerequisite for Math. 50.

36. HIGH SCHOOL ALGEBRA.
   Noncredit course. 58.
   Algebraic fractions, graphs, laws of fundamental operations, factors, linear equations, exponents and radicals, ratio-proportion-variation, logarithms, progressions, binomial theorem and inequalities. This course may be used to satisfy the third one-half unit of the high school algebra prerequisite for Math. 50.

40. BASIC MATHEMATICS.
    (5-0) Cr. 5. W.
    Algebra, including exponents and logarithms; basic mathematics of finance. Applications of statistics; graphs.

50, 51, 52. APPLIED MATHEMATICS I, II, III.
   (5-0) Cr. 5 each. 50: F.W; 51: W.S; 52: F.S.S.
   Prerequisite: 50: One and one-half units of high school algebra and one unit of high school geometry; 51: 50 or equivalent; 52: 51 or equivalent.
   50: Simultaneous linear equations, coordinate systems, logarithms and exponentials, trigonometric functions. 51: Trigonometric functions, complex numbers, vectors, quadratic equations. 52: Analytic geometry of simple conics, differential and integral calculus.

Mechanical Technology

75. MECHANICAL STANDARDS.
    (1-3) Cr. 2. F.S.
    Prerequisite: A.Gr. 45.
    The origin and purpose of standards. Responsibility for development and maintenance of standards. Familiarization with the National Bureau of Standards, American Standards Association, ASME, and other technical organizations which prepare standards in mechanical and allied fields. Detailed study of selected codes and standards.

76. MECHANICAL PROCESSES.
    (0-6) Cr. 2. F.W.
    Metal cutting operations. Basic machine tools. Planning and selection of the best method of producing parts by machine tools.

78. MECHANISMS.
    (3-0) Cr. 3. F.B.
    Prerequisite: A.Gr. 48.
    Methods of predicting displacements and accompanying velocities and accelerations in mechanical linkages. Synthesis of mechanisms to solve design requirements.
79. METALS AND ALLOYS.
   (2-3) Cr. 3. W.S.
   Prerequisite: Chem. 70.
   Basic principles of physical metallurgy. Structure and solidification of metals, alloy systems and phase transformations of both ferrous and nonferrous metals. Testing and microscopic examination of typical metals.

80. METAL PROCESSING.
   (2-3) Cr. 3. S.S.S.
   Prerequisite: 79.

81. DESIGN TECHNOLOGY I.
   (3-3) Cr. 4. W.S.
   Prerequisite: 78, credit or classification in A.M. 32.
   Design of components of machines by the application of principles of mechanics and kinematics. Selection of standard components. Creative solutions to technical problems.

82. DESIGN TECHNOLOGY II.
   (2-6) Cr. 4. S.S.S.
   Prerequisite: 81.
   Selected electives in the design of machines and systems. Project to be chosen in area of student's interest to provide practice in application of design principles including specification of materials and estimates of cost of production.

85. ELEMENTS OF THERMODYNAMICS.
   (3-0) Cr. 3. W.S.
   Prerequisite: Phys. 71, Chem. 70.
   Properties of fluids. Thermodynamics laws and equations. Use of tables and charts of thermodynamic properties of important fluids. Heat and fluid flow.

86. APPLIED THERMODYNAMICS.
   (3-0) Cr. 3. S.S.S.
   Prerequisite: 85.
   Application of thermodynamics and flow relationships to the performance of machines and systems used for producing, transforming, and applying heat and mechanical energy.

87. FLUID POWER.
   (3-0) Cr. 3. S.S.S.
   Prerequisite: 85.
   Fundamental concepts of fluid mechanics. Transmission and control of fluids in practical hydraulic systems.

90. MEASUREMENTS LABORATORY.
   (1-6) Cr. 3. S.S.S.
   Prerequisites: 85, E.Tch. 72.
   Principles of measurement. Laboratory practice in the characteristics and use of instruments used for the measurement of temperature, pressure, flow and other variables. Preparation of reports.

Physics

71. APPLIED PHYSICS I.
   (2-5) Cr. 4. F.W.
   Prerequisite: Credit or classification in Math. 50.
   Principles of measurement, kinematics, dynamics, mechanical energy and heat, and geometrical optics with applications in engineering technology.

72. APPLIED PHYSICS II.
   (2-5) Cr. 4. W.S.
   Prerequisite: 71.
   Principles of statics, elasticity, fluids, electricity and magnetism, and geometrical optics with applications in engineering technology.

73. APPLIED PHYSICS III.
   (2-5) Cr. 4. F.S.
   Prerequisite: 72 or credit or classification in E.Tch. 86.
   Principles of physical optics, modern physics and energy conversion methods with applications in engineering technology.

Psychology

50. PSYCHOLOGY OF INTERPERSONAL RELATIONSHIPS.
   (4-0) Cr. 4. F.
   Applications of principles of psychology to interpersonal relationships such as between workers, between supervisors and subordinates, and between businesses and consumers, with reference to their effects on the job performance and satisfaction of employees and the persuasive impact on the public.

Sociology

35. HUMAN RELATIONS.
   (4-0) Cr. 4. W.
   Basic principles of sociology for understanding society and man's behavior in groups.

Speech

30. PUBLIC SPEAKING.
   (3-0) Cr. 3. F.W.S.S.S.
   Prerequisite: Engl. 21.
   Basic elements of public speaking, including content and organization; practice in the preparation and delivery of speeches.

Textiles and Clothing

40. INSTITUTION TEXTILES.
   (4-2) Cr. 4. F.
   Practical study of fiber, yarns, weaves, and finishes with reference to selection and care of fabrics used in food and housing institutions.
## Summary of Degrees Conferred

### 1872-1970

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# Summary of Enrollment

## ENROLLMENT 1968-69

A summary of different individuals enrolled during the year

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| II. Students not in residence of college grade extension, off-campus | | | | | |
| 162 | 45 | 207 | 169 | 46 | 215 |

| III. Students in residence not of college grade music, driver training and nursery school | | | | | |
| 153 | 126 | 279 | 201 | 164 | 365 |
# ENROLLMENT 1969-70

A summary of different individuals enrolled during the year

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<th>Women</th>
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<th>Fiscal Year</th>
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<th>Women</th>
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### SUMMER QUARTER STUDENTS 1968

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<th>First Term Only</th>
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<th>Twelve Weeks</th>
<th>Total</th>
<th>Summer and Academic Year</th>
<th>Students Attending Summer Only</th>
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| II. Students not in residence of college grade extension, off-campus | 23              | 4                | 2         | 29     | 21                       | 8                             |

| III Students in residence not of college grade music, driver training and nursery school | 121             |                  |           | 121    | 121                      | 121                           |

### SUMMER QUARTER STUDENTS 1969

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<tr>
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<th>First Term Only</th>
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<th>Total</th>
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| II. Students not in residence of college grade extension, off-campus | 13              | 1                | 3         | 17     | 2                        | 15                            |

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