William Robert Parks
President
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 overall responsibility for the administration of the central office of the Board located in Des Moines.
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

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

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

J. Boyd Page, Ph.D.
Vice President for Research
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.
Dean of the College of Education

George R. Town, D.Eng.
Dean of the College of Engineering

Helen R. LeBaron, Ph.D.
Dean of the College of Home Economics

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

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

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

Eugene E. Robinson, 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

Boyne H. Platt, B.S.
Coordinator of Planning

Samuel A. McDowell
Treasurer

Joseph E. Marks, M.A., C.P.A.
Associate Vice President for Business and Finance

Delbert H. Ostermann
Director of Purchasing and Stores

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

Ben W. Schaefer, B.S.
Superintendent 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 more than 42,000 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 one thousand 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 1968 was in excess of $141 million, including $114 million owned by the University and the rest by affiliated organizations. The University’s anticipated expenditure in 1968-69 was approximately $75.5 million, of which state appropriations provided about 38 percent. The remainder came from fees, contracts, sales, private gifts and grants, federal funds and endowment.
University Calendar 1969-1970

FALL QUARTER 1969

Monday, Sept. 1
Wednesday, Sept. 3
Thursday, Sept. 4
Friday, Sept. 5
Friday, Sept. 5, 1-5 p.m.

University Holiday, Offices Closed
Orientation Days Begin
Registration Begins
Registration Ends
Examination to Secure Advance Standing or Remove
Incompletes
Orientation Days End
Class Work Begins
End of Fee Payment Period
Senior and Graduate English Examination
Mid-quarter Reports Due
Final Date for Filing Diploma Cards
Classes Dismissed for Homecoming
Classes Resumed Following Homecoming
Last Day Courses May Be Dropped
Examinations Begin
Examinations End
Graduation
University Holiday, Offices Closed

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WINTER QUARTER 1970

Monday, Dec. 1

Monday, Dec. 1
Tuesday, Dec. 2
Wednesday, Dec. 3, 4 p.m.
Thursday, Dec. 11, 4-6 p.m.
Saturday, Dec. 20, 12 noon
Thursday-Friday, Dec. 25-26
Thursday, Jan. 1
Monday, Jan. 5, 7 a.m.
Friday, Jan. 16
Friday, Jan. 16
Friday, Feb. 6
Monday, Feb. 23
Friday, Feb. 27
Saturday, Feb. 28

Examinations to Secure Advance Standing or to Remove
Incompletes
Registration
Class Work Begins
End of Fee Payment Period
Senior and Graduate English Examination
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 Courses May Be Dropped
Examinations Begin
Examinations End
Graduation

*Students in residence preceding quarter will register during the examination week of that quarter.*
SPRING QUARTER 1970

Monday, March 9

*Monday, March 9
Tuesday, March 10
Wednesday, March 11, 4 p.m.
Thursday, March 19, 4-6 p.m.
Thursday, March 26, 6 p.m.
Monday, March 30, 7 a.m.
Friday, April 10
Friday, April 10
Thursday, Friday
  Saturday, May 7, 8, 9
Friday, May 8
Friday, May 22
Thursday, May 28
Friday, May 29
Friday, May 29

Examinations to Secure Advance Standing or to Remove Incompletes
Registration
Class Work Begins
End of Fee Payment Period
Senior and Graduate English Examination
Easter Recess Begins
Class Work Resumes
Mid-quarter Reports Due
Final Date for Filing Diploma Cards

Veishea, Classes Dismissed 12 Noon Thursday
Last Day Courses May Be Dropped
Examinations Begin
Examinations End
Graduation
University Holiday, Offices Closed

SUMMER QUARTER 1970

Monday, June 8
Tuesday, June 9
Wednesday, June 10, 4 p.m.
Thursday, June 18, 4 p.m.
Friday, July 3
Tuesday, July 14
Tuesday, July 14
Wednesday, July 15
Thursday, July 16, 4 p.m.
Thursday, July 23, 4 p.m.
Friday, August 21
Saturday, August 22

Registration
Class Work Begins
End of Fee Payment Period
Senior and Graduate English Examination
University Holiday, Offices Closed
First Session Ends
Registration
Class Work Begins
End of Fee Payment Period
Senior and Graduate English Examination
Second Session Ends
Graduation

*Students in residence preceding quarter will register during the examination week of that quarter.
University Calendar / 1970-1971

FALL QUARTER 1970

Wednesday, Sept. 2
Thursday, Sept. 3
Friday, Sept. 4
Friday, Sept. 4, 1-5 p.m.
Sunday, Sept. 6
Monday, Sept. 7
Tuesday, Sept. 8
Wednesday, Sept. 9, 4 p.m.
Thursday, Sept. 17, 4-6 p.m.
Friday, Oct. 9
Friday, Oct. 9
Friday, Oct. 30
Friday, Oct. 30, 12 Noon
Monday, Nov. 2, 12:10 p.m.
Monday, Nov. 16
Friday, Nov. 20
Saturday, Nov. 21
Thursday, Nov. 26

Orientation Days Begin
Registration Begins
Registration Ends
Examinations to Secure Advance Standing
Orientation Days End
University Holiday, Offices Closed
Class Work Begins
End of Fee Payment Period
Senior and Graduate English Examination
Mid-quarter Reports Due
Final Date for Filing Diploma Cards
Last Day Courses May Be Dropped
Classes Dismissed for Homecoming
Classes Resumed Following Homecoming
Examinations Begin
Examinations End
Graduation
University Holiday, Offices Closed

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<td>24 25 26 27 28 29 30</td>
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WINTER QUARTER 1971

Monday, Nov. 30

*Monday, Nov. 30
Tuesday, Dec. 1
Wednesday, Dec. 2, 4 p.m.
Thursday, Dec. 10, 4-6 p.m.
Saturday, Dec. 19, 12 Noon
Thursday-Friday, Dec. 24-25
Friday, Jan. 1
Monday, Jan. 4, 7 a.m.
Friday, Jan. 15
Friday, Jan. 15
Friday, Feb. 5
Monday, Feb. 22
Friday, Feb. 26
Saturday, Feb. 27

Examinations to Secure Advance Standing or to Remove Incompletes
Registration
Class Work Begins
End of Fee Payment Period
Senior and Graduate English Examination
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 Courses May Be Dropped
Examinations Begin
Examinations End
Graduation

*Students in residence preceding quarter will register during the examination week of that quarter.
SPRING QUARTER 1971

Monday, March 8

*Monday, March 8
Tuesday, March 9
Wednesday, March 10, 4 p.m.
Thursday, March 18, 4-6 p.m.
Thursday, April 8, 6 p.m.
Friday, April 9
Friday, April 9
Monday, April 12, 7 a.m.
Thursday, Friday,
      Saturday, May 6, 7, 8
Friday, May 7
Monday, May 24
Friday, May 28
Saturday, May 29
Monday, May 31

Examinations to Secure Advance Standing or to Remove
Incomplete
Registration
Class Work Begins
End of Fee Payment Period
Senior and Graduate English Examination
Easter Recess Begins
Mid-quarter Reports Due
Final Date for Filing Diploma Cards
Class Work Resumes

Veishea, Classes Dismissed 12 Noon Thursday
Last Day Courses May Be Dropped
Examinations Begin
Examinations End
Graduation
University Holiday, Offices Closed

SUMMER QUARTER 1971

Monday, June 7
Tuesday, June 8
Wednesday, June 9, 4 p.m.
Thursday, June 17, 4 p.m.
Monday, July 5
Tuesday, July 13
Tuesday, July 13
Wednesday, July 14
Thursday, July 15, 4 p.m.
Thursday, July 22, 4 p.m.
Friday, Aug. 20
Saturday, Aug. 21

Registration
Class Work Begins
End of Fee Payment Period
Senior and Graduate English Examination
University Holiday, Offices Closed
First Session Ends
Registration
Class Work Begins
End of Fee Payment Period
Senior and Graduate English Examination
Second Session Ends
Graduation

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

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

ABRAHAM, WILLIAM H., Professor of Chemical Engineering
B.Ch.E., 1952, Cornell; Ph.D., 1957, Purdue

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

ADAMS, WILLIAM M., Associate Professor of Veterinary Clinical Sciences

AHRENS, DONALD L., Instructor in Agricultural Engineering
B.S., 1964, M.S., 1966, Iowa State

AHRENS, FRANKLIN A., Assistant 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., 1951, 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

ALLEN, WILLIAM H., JR., Associate, Agronomy
B.A., 1962, M.S., 1963, Mississippi

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

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

AI-NAKEEB, SHAHEEN, Instructor in Veterinary Clinical Sciences, Biomedical Engineering
B.V.M., 1962, Baghdad (Iraq); M.S., 1966, Iowa State

ALTSCHUL, MONIQUE, Instructor in Foreign Languages
M.A., 1964, Buenos Aires (Argentina)

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

ANDERSEN, JOHN R., Assistant Professor of Veterinary Clinical Sciences
D.V.M., 1959, M.S., 1965, Iowa State

ANDERSON, ARTHUR L., Professor of Animal Science
B.S., 1916, Minnesota; M.S., 1922, Iowa State
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  
B.A., 1958, Luther

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, JANICE M., Instructor in Applied Art  

ANDERSON, JOHN R., Assistant Professor of Veterinary Clinical Sciences  
D.V.M., 1959, M.S., 1965, Iowa State

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

ANDERSON, MARVIN A., Professor of Agronomy; Dean of University Extension and Director of the Cooperative Extension Service  
B.S., 1939, M.S., 1949, Ph.D., 1955, Iowa State

ANDERSON, PAUL M., Professor of Electrical Engineering  
B.S., 1949, M.S., 1958, Ph.D., 1961, Iowa State

ANDERSON, RUSSELL D., Instructor in Electrical Engineering  

ANDERSON, VINCENT M., Associate Professor, District Extension Director, University Extension  
B.S., 1924, Iowa State

ANDERSON, WILLARD R., Assistant Professor of Agricultural Engineering  
B.S., 1950, M.S., 1952, Iowa State

ANDERSON, THOMAS K., Instructor in Industrial Administration  

ANDRE, FLOYD, Professor of Entomology; Dean of the College of Agriculture; Director of the Agriculture and Home Economics Experiment Station  
B.S., 1931, M.S., 1933, Ph.D., 1936, Iowa State

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

ANKER, DONALD E., Instructor in Electronics Technology  
B.S., 1962, Iowa State

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

ARDINE, FRANCIS H., GySgt., USMC, Instructor in Naval Science

ARGANBRIGHT, DEANE E., Assistant Professor of Mathematics  

ARNBAL, 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  

ARNOLD, CAROLE R., Assistant Professor of Child Development; 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, Serials Librarian, Library  
B.S., 1959, Florida State; M.L.S., 1968, Oklahoma

ARNOLD, VICKI L., Associate, Animal Science  
B.S., 1968, Northeast Missouri State

ARNRICH, 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  
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

AUERBACH, AARON G., Assistant Professor of Child Development  

AUGUSTINE, GRACE M., Professor Emeritus of Institution Management  
B.S., 1929, M.A., 1930, Ph.D., 1935, Columbia

AVANT, LLOYD L., Assistant Professor of Psychology  

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

AVRAAMIDES, ACHILLES, Instructor in History  

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

BACHMAN, ROBERT Z., Associate, Institute for Atomic Research  
B.S., 1951, Iowa State

BACHMANN, ROGER W., Associate Professor of Fisheries Biology  
B.S., 1956, Ph.D., 1962, Michigan; M.S., 1958, Idaho

BAILEY, DONALD M., Assistant Professor of Metallurgy  
B.S., 1954, Illinois State; M.S., 1961, Iowa State

BAILEY, MERRITT E., JR., Associate Professor of Technical Journalism; Director of Book Publishing  
B.S., 1949, M.S., 1951, Iowa State

BAKER, DURWOOD L., Professor of Veterinary Medicine and Surgery; Associate Dean of the College of Veterinary Medicine  
D.V.M., 1943, Iowa State

BAKER, HARLAN K., Associate Professor, Engineering Extension  
B.S., 1963, M.S., 1967, Iowa State

BAKER, HAROLD D., Assistant Professor of Statistics  
B.S., 1958, M.S., 1963, Iowa State

BAKER, JAMES D., Instructor in Mathematics  

BAKER, JOHN R., Assistant Professor of Zoology  
B.S., 1952, M.S., 1956, Wyoming; Ph.D., 1966, Minnesota

BAKER, RONALD D., Assistant Professor of Psychology; Counseling Psychologist, Student Counseling Service  

BAKER, THOMAS W., Instructor in English  

BAKKE, ARTHUR L., Professor of Botany  
B.S., 1909, M.S., 1911, Iowa State; Ph.D., 1917, Chicago

BAL, HARPAL S., Instructor in Veterinary Anatomy  
B.V.Sc., 1953, Punjab (India); M.S., 1966, Iowa State

BALL, A. GORDON, Professor of Economics  
B.S., 1949, Toronto (Canada); M.S., 1950, Ph.D., 1954, Iowa State

BALL, ROGER A., Associate Professor of Veterinary Pathology, Veterinary Medical Research Institute  
D.V.M., 1954, Iowa State; Ph.D., 1964, Minnesota

BALLANTYNE, CHARLES R., Associate Professor of Agronomy  
B.A., 1930, M.A., 1931, Iowa

BANKS, CHARLES V., Professor of Chemistry; Section Chief, Chemistry Division, Ames Laboratory  
A.B., 1927, Florida; A.M., 1934, Michigan; Ph.D., 1943, Iowa State

BANKS, CHARLES V., Professor of Chemistry; Section Chief, Chemistry Division, Ames Laboratory  
B.Ed., 1941, Western Illinois; M.S., 1944, Ph.D., 1946, Iowa State

BANNISTER, DWIGHT M., Associate Professor, Assistant Extension Editor, Cooperative Extension Service  
B.S., 1928, Northwestern
BARNES, WILFRED E., Professor of Nuclear Engineering  
B.S., 1945, U.S. Naval Academy; B.S., 1948, Massachusetts Institute of Technology; M.A., 1961, East Carolina; Ph.D., 1966, Iowa State

BARDI, EDWARD J., Instructor in Industrial Administration  

BARNES, RICHARD G., Professor of Physics  

BARNES, WILFRED E., Professor of Mathematics and Head of the Department  
S.B., 1949, S.M., 1950, Chicago; Ph.D., 1954, British Columbia (Canada)

BARNETT, ROBERT B., COL., USA, Professor of Military Science and Head of the Department  
B.S., 1955, Indiana

BARRY, MARYANNE, Instructor in English  

BARTON, THOMAS A., Professor of Landscape Architecture and Head of the Department  
B.S., 1941, M.L.A., 1960, Iowa State

BARTON, THOMAS J., Instructor in Chemistry  
B.S., 1962, Lamar State; Ph.D., 1967, Florida

BARTZ, WAYNE H., Associate Professor of Psychology  

BATESON, BERNICE, Associate, District Leader, Home Economics, Cooperative Extension Service  
B.S., 1928, M.S., 1967, Iowa State

BATH, JOHN A., Professor of Psychology, Professor of Education  
A.B., 1932, Peru State, M.A., 1933, Ph.D., 1942, Nebraska

BATHIE, WILLIAM W., Assistant Professor of Mechanical Engineering  
B.S., 1957, M.E., 1967, Iowa State

BAUMANN, E. ROBERT, Professor of Civil Engineering  

BAUMEL, C. PHILLIP, Associate Professor of Economics  
B.Sc., 1950, M.Sc., 1957, Ohio State; Ph.D., 1961, Iowa State

BAUSKE, ROBERT J., Assistant Professor of Horticulture  
B.A., 1943, Carleton; Ph.D., 1966, Iowa State

BEAL, GEORGE M., Professor of Sociology and Head of the Department of Sociology and Anthropology  
B.S., 1943, M.S., 1947, Ph.D., 1953, Iowa State

BEARD, JESS R., Associate Professor of Education; in Charge of Elementary Education  
B.S., M.S., 1947, Illinois; Ed.D., 1958, George Peabody

BEATTIE, THOMAS A., Assistant Professor of Institution Management  
B.S., 1950, Cornell University; M.Ed., 1964, Illinois

BEATTY, JAMES D., Instructor in English  
B.S., 1964, Iowa State; M.A., 1966, Iowa

BEAUDRY, BERNARD J., Associate, Institute for Atomic Research  
B.A., 1954, St. John's; M.S., 1959, Iowa State

BEAVERS, IRENE, Associate Professor of Home Economics Education  
B.S., 1948, George Peabody; M.S., 1953, Iowa State; Ph.D., 1962, Wisconsin

BEAVERS, WILLET I., Assistant Professor of Physics  
B.S., 1955, M.S., 1959, Missouri; Ph.D., 1965, Indiana

BECK, ALLAN R., Associate, Horticulture  
B.S., 1956, Iowa State

BEER, CRAIG E., Associate Professor of Agricultural Engineering  
B.S., 1950, M.S., 1957, Ph.D., 1962, Iowa State

BEESON, ROBERT E., Instructor in Electrical Engineering  
B.S., 1961, M.S., 1964, Iowa State

BEHM, GARY W., Instructor in Music  
B.M., 1958, M.A., 1965, Iowa

BEITZ, DONALD C., Assistant Professor of Biochemistry and Biophysics; Assistant Professor of Animal Science  

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B.S., 1917, Minnesota; E.E., 1926, M.S., 1929, Iowa State

WILLIS, FRANKLIN E., Maj., USAF, Assistant Professor of Air Force Aerospace Sciences
B.S., 1955, Minnesota; M.S., 1964, Tennessee

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A.B., 1913, Valparaiso; B.S., 1914, Chicago

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A.B., 1939, Guilford; M.A., 1941, North Carolina; Ph.D., 1958, Columbia

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A.B., 1950, Illinois; M.S., 1951, Drexel; Ph.D., 1960, Iowa State

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A.B., 1931, B.S., 1932, M.S., 1938, Illinois

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B.S.E.E., 1960, M.S., 1963, North Dakota

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WISHART, DONALD J., Associate, Assistant Extension Editor, Information Service
B.S., 1962, Iowa State

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B.S., 1941, Wisconsin State; M.S., 1953, Wisconsin

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YATES, NORRIS W., Professor of English  

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YOUNG, JAMES C., Assistant Professor of Civil Engineering  
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B.S., 1939, Case; M.S., 1948, Ph.D., 1949, Indiana

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B.A., 1959, University College (England); M.A., 1968, Indiana

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B.S., 1947, Mankato State Teachers; M.S., 1952, Ph.D., 1955, Iowa State

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B.S., 1944, M.S., 1951, Iowa State

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B.A., 1940, M.Litt., 1943, Ph.D., 1950, Pittsburgh

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B.Sc., 1953, McGill (Canada); M.A., 1954, Toronto (Canada); Ph.D., 1958, Iowa State

ZYTOWSKI, DONALD G., Associate Professor of Psychology; Counseling Psychologist, Student Counseling Service  
UNIVERSITY EXTENSION FIELD OPERATIONS

CEDAR RAPIDS AREA
Russell Swenson, Area Extension Director
Andrew C. Boston, Extension Livestock Production Specialist
David H. Hammond, Extension Resource Development Specialist
Vivan 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
Henrietta VanMaanen, Extension Home Economist

Jay A. West, Extension Crop Production Specialist
Enid W. Wortman, Extension Consumer and Management Specialist

AUDUBON COUNTY, Audubon
David C. Fenske, Director
*R. Lynn Benson, 4-H and Youth Leader

CASS COUNTY, Atlantic
A. Daniel Merrick, Director
*LaVon M. Eblen, Home Economist

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Richard M. McClure, Director
*R. Lynn Benson, 4-H and Youth Leader

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Paul W. Watts, Director
*Gary G. Guge, 4-H and Youth Leader

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*Barbara J. Buffington, Home Economist
*Paul D. Hopp, Assistant

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J. Clifford Johnson, Director
Carol H. Beckman, Home Economist

SHELBY COUNTY, Harlan
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Stanley J. Murdock, Extension Crop Production Specialist
Richard J. Nanneman, Extension Resource Development Specialist
T. Raymond Powell, Extension Farm Management Specialist

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Mary Sue Whistler, Home Economist

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*Dorothy T. Keith, Home Economist

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Richard J. Nanneman, Extension Resource Development Specialist
T. Raymond Powell, Extension Farm Management Specialist
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Marsha L. Nowels, Assistant

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*Linda C. Reece, Home Economist
*Dale W. Wagner, 4-H and Youth Leader

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*Lillian K. Price, Home Economist
*William F. Short, Jr., 4-H and Youth Leader

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*Eugene J. Carroll, Associate

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J. Neil Chicken, Director

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Ronald C. Sanson, Director
*Helen M. Meyers, Home Economist

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Steve A. Evans, Director
*Dorothy E. Bartleson, Home Economist
*James F. Kearns, Associate

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Richard D. Munster, Area Extension Director
Gene B. Vincent, Extension Crop Production Specialist
Harrie R. Buswell, Electronics and Technical Education, Engineering Extension
Robert A. Lyon, Industrial Specialist, CIRAS

CLINTON COUNTY, DeWitt
Norman J. Goodwin, Director
Helen Whittington, Home Economist
Jimmy W. Miller, 4-H and Youth Leader

DES MOINES COUNTY, Burlington
James C. Hodges, Director
*Martha J. Bechel, Home Economist

HENRY COUNTY, Mount Pleasant
Richard L. Thuma, Director
*Lester D. Schoffelman, 4-H and Youth Leader

LEE COUNTY, Donnellson
Robert N. Dowling, Director
Granda B. Holleywell, Home Economist

LOUISA COUNTY, Wapello
Gaylord D. Elliott, Director
Emogene Y. Brown, Home Economist

MUSCATINE COUNTY, Muscatine
Eugene Mathern, Director
John F. Wanfalt, 4-H and Youth Leader

SCOTT COUNTY, Davenport
Donald P. Olson, Director
Lettie E. Zuber, Home Economist
*Mabel W. Flint, Home Economist
Raymond E. Wagner, 4-H and Youth Leader

DES MOINES AREA
Vincent M. Anderson, Area Extension Director

DALLAS COUNTY, Adel
J. Dwight Brown, Director
Ellen R. Thomas, Home Economist
*Douglas C. Henderson, Assistant

GUTHRIE COUNTY, Guthrie Center
David R. May, Director

HARDIN COUNTY, Eldora
James H. Goode, Director
*Mary Anne Gibson, Assistant

JASPER COUNTY, Newton
Jasper M. Risdal, Director
Beulah M. Gray, Home Economist

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*Richard L. Horne, 4-H and Youth Leader

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Beatrice J. Brock, Home Economist
Ober J. Anderson, Associate
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Paul D. Walet, Youth Leader, Model Cities Program

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*Max S. Schmidt, 4-H and Youth Leader

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Karl W. Griffith, Associate
Glenda L. Biddle, Assistant

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Marvin L. Smart, Director
Bertha Mae Kelly, Home Economist
Frank L. Wyatt, Assistant

DUBUQUE AREA
Glendon W. Kuiper, Area Extension Director
L. J. Bodensteiner, Extension Farm Management Specialist
Charles D. Colvin, Extension Resource Development Specialist
Wayne P. Dietz, Extension Crop Production Specialist
<table>
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<tr>
<th>County</th>
<th>City</th>
<th>Director</th>
<th>Assistant/Leader</th>
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<tr>
<td>Allamakee</td>
<td>Waukon</td>
<td>E. Lee Gruenhaupt</td>
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<td>Clayton</td>
<td>Elkader</td>
<td>James C. Hosch</td>
<td>Mary Jane Blumhagen</td>
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<td>Delaware</td>
<td>Manchester</td>
<td>Robert E. Hall</td>
<td>* Marilyn J. Olson, Home Economist</td>
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<tr>
<td>Dubuque</td>
<td>Dubuque</td>
<td>Gerald J. McGrane</td>
<td>* Bonnie R. Voss, Assistant</td>
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<tr>
<td>Fayette</td>
<td>Fayette</td>
<td>Melvin C. Wangsness</td>
<td>Harold L. Boulton</td>
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<td>Howard</td>
<td>Cresco</td>
<td>Harold A. Alert</td>
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<td>Jackson</td>
<td>Maquoketa</td>
<td>John E. Henderson</td>
<td>Catherine Ruth, Home Economist</td>
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<tr>
<td>Winneshiek</td>
<td>Decorah</td>
<td>E. J. Weigle</td>
<td>* Mary Jane Leuenberger, Home Economist</td>
</tr>
</tbody>
</table>

**FORT DODGE AREA**

Lloyd M. Reid, Area Extension Director

Clarence E. Babcock, Extension Crop Production Specialist

Michael A. Fowler, Extension Livestock Production Specialist

James E. Hughes, Extension Farm Management Specialist

Clarence E. Rice, Extension Resource Development Specialist

**Boone County**

T. N. Nelson, Director

Virginia P. Bishop, Home Economist

Dean M. King, 4-H and Youth Leader

**Calhoun County**

W. Hal Speers, Director

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**Carroll County**

Roland F. Lickteig, Director

Lucile Buchanan, Home Economist

*W. Robert Millender, 4-H and Youth Leader

**Greene County**

Warren D. Raney, Director

Alice J. Walters, Home Economist

**Hamilton County**

C. Lynn Habben, Director

Mae Belle Godown, Home Economist

Shirley J. Stakey, 4-H and Youth Leader

**Humboldt County**

Norman W. Moklestad, Director

Myrtle Hewitt, Home Economist

**Pocahontas County**

Darrell E. Clark, Director

Ellen D. Hoppe, 4-H and Youth Leader

**Webster County**

Joseph E. Narigon, Director

Verla B. Ulish, Home Economist

Bruce B. Wilde, 4-H and Youth Leader

**Wright County**

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Geraldine S. Steele, Home Economist

William D. Sundell, 4-H and Youth Leader

**Mason City Area**

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*Phyllis H. Seymour, Home Economist

*Marcia M. McArthur, 4-H and Youth Leader

**Floyd County**

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**Franklin County**

R. Pearl Kelsey, Director

Nancy J. Severtson, Assistant

**Hancock County**

Paul Henderson, Director

*Elsie Mae Van Wert, Home Economist

*K. Keith Kimberlin, 4-H and Youth Leader

**Mitchell County**

Edgar W. Dorow, Director

*May Johnson, 4-H and Youth Leader

**Winnebago County**

Richard W. Anderson, Director

**Worth County**

Neil E. Bulman, Director

*Florence Ferden, Home Economist
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Clifford I. Iverson, Extension Livestock Production Specialist
Richard J. Mikes, Extension Business Management Specialist
Allan L. Seim, Extension Crop Production Specialist

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Harold D. Holder, Director
*Inga O. Eddy, Home Economist

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William D. Byers, Director
*Esther L. Hubbartt, Home Economist

JEFFERSON COUNTY, Fairfield
Stanley R. Stover, Director

KEOKUK COUNTY, Sigourney
Donald A. Shirk, Director
*Adelena S. Clark, Home Economist

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Joe D. Miller, Director

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*John W. Patterson, 4-H and Youth Leader

MARION COUNTY, Knoxville
Richard T. Freeman, Director
*Ruth S. Archibald, Home Economist

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James D. Johnson, Director

VAN BUREN COUNTY, Keosauqua
Melvin L. Powers, Director
*Edna C. Morris, Home Economist

WAPELLO COUNTY, Ottumwa
Dale M. Uehling, Director
*Harold L. Craig, 4-H and Youth Leader

WAYNE COUNTY, Corydon
F. Wayne Hart, Director
*Donald A. Lusch, 4-H and Youth Leader

SIoux CITY AREA

Roger D. Iverson, Area Extension Director
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
Chester C. Benson, 4-H and Youth Leader

CRAWFORD COUNTY, Denison
Maclyn E. LaRue, Director
*Norma L. Morgan, Home Economist
*Richard L. Schoffelman, Assistant
*Anna L. Haire, 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, Assistant
*Floyd Schnirring, 4-H and Youth Leader

WOODBURY COUNTY, Sioux City
Bruce W. Marcue, Director
Dorothy J. George, Home Economist
Robert J. Ramsey, 4-H and Youth Leader

SPENCER AREA

W. John Johnson, Jr., Area Extension Director
DeVon F. Andrus, Extension Livestock Production Specialist
Dean L. Barnes, Extension Crop Production 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
Doyle N. Gorden, Director
*Richard N. Haack, 4-H and Youth Leader
*Marilyn M. Kirchner, Assistant

EMMET COUNTY, Estherville
Gene Rulstad, Director
Margarette P. Pro, 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
Raymond H. Dirksen, Director
PALO ALTO COUNTY, Emmetsburg
Harold H. Heykes, Director
*Margaret D. Pratt, Home Economist
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Maurice E. Eldridge, Director
Gary L. Bredensteiner, 4-H and Youth Leader

WATERLOO AREA
Alvin T. Goettsch, 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
Marjorie D. Warner, Home Economist
Joanne M. Vlasak, Home Economist

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Dale G. Shires, Director
Pearl E. Pardee, Home Economist
*Kermit J. Hildahl, 4-H and Youth Leader

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Jay I. Partridge, Director
Gene R. McBride, Associate
Judith G. Sandin, Assistant

BUTLER COUNTY, Allison
Gary S. Frahm, Director
Roberta R. Wiegmann, Home Economist

CHICKASAW COUNTY, New Hampton
Gerald K. Anderson, Director

GRUNDY COUNTY, Grundy Center
Everett D. Halstead, Director
Genevieve Craven, Home Economist

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

*Has multi-county responsibility
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Robert B. Boyd, Technical Services Representative
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Donald I. McKeown, Professional Development Service Center
Lynn D. Richardson, Industrial Specialist
Edward O. Sealine, Industrial Specialist
Robert W. Shearer, Industrial Specialist
Blaine F. Vandeventer, Staff Engineer

FIELD STAFF
James W. Klemme, Industrial Specialist, Mason City, Fort Dodge and Waterloo Areas
Robert A. Lyon, Industrial Specialist, Davenport and Dubuque Areas
Linferd C. McGrane, Industrial Specialist, Spencer, Sioux City and Council Bluffs Areas
Norril A. Rogness, Industrial Specialist, Cedar Rapids and Ottumwa Areas
James M. Schaaf, Industrial Specialist, Polk County
John H. Wessman, Industrial Specialist, Creston and Des Moines Areas
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, 1968, there were 2,769 who received the baccalaureate or an advanced degree.

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. Co-educational 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 four quarters of approximately 11 weeks each. Most undergraduates attend three quarters, September to June, but an increasing number are taking advantage of the summer program.

In 1968 Iowa State had an enrollment of more than 18,000 and a faculty which numbered more than 1,500.
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
- Dairy Science
- Entomology
- Farm Operation
- Fisheries and Wildlife Biology
- Food Technology
- Forestry
- Horticulture
- Landscape Architecture
- Plant Pathology
- Poultry Science
- Public Service and Administration in Agriculture
- Resource Development for Outdoor Recreation
- Urban Planning

Leading to a Certificate in Technical Agriculture:

- Agricultural Business
- Agronomy
- Animal Science
- Dairy Science
- Farm Operation
- Horticulture
- Poultry Science

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
- Building Construction
- 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 for General Education

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:

Technical Agriculture
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 R. LeBaron, 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 experiment with livestock, crops and horticultural material. The Hatch Act, passed by Congress in 1887, gave federal support to agricultural investigations, and 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
- agricultural engineering
- agricultural journalism
- agricultural statistics
- agronomy
- animal pathology
- animal science
- biochemistry
- dairy and food industry economics
- education
- entomology
- fisheries and wildlife biology
- forestry
- genetics
- home economics
- horticulture
- plant pathology
- poultry science
- sociology
- technical journalism

HOME ECONOMICS RESEARCH INSTITUTE

Helen R. LeBaron, 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 is supported by governmental, business, and industrial agencies and associations and by foundations, and is conducted by faculty assisted by students. 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, and textiles and clothing.
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 the academic departments.

Major research personnel of the Institute are also active in teaching, and a large portion of the research activities 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 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, measurement equipment and an editorial service.

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

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
- geology
- foreign languages
- 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 co-workers 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 peace time, 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 peace time uses of atomic energy and the by-products from it. Specifically, its purposes are:

1. 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.
2. 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.
3. 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.
4. 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 post-war 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.

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 func­
tions 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 re­
ceives 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 pic­
ture which includes history, symptoms, treatments, postmortem examination, gross and micro­
scopic examinations and a host of diagnostic procedures and techniques in all veterinary med­
ical 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 physical plant of the laboratory is modern and is equipped with diagnostic and ana­
lytical facilities and instrumentation used in microbiological, chemical, toxicological and patho­
logical examination.
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.
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 and programming service. The Center maintains a variety of computing facilities ranging from unit record equipment through large scale digital computers. Peripheral equipment includes an analogue-to-digital conversion system and a digital plotter.

The Center offers short, non-credit courses in computer programming and provides liaison for academic departments offering formal courses in computer sciences. Research encompasses numerical mathematics, programming research and digital computer systems.

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.

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.

The Center is concerned with the 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.
• 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 government.

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. In addition to this, the University provides substantial financial support.
UNIVERSITY EXTENSION
Marvin A. Anderson, Ph.D., Dean

University Extension was established March 1, 1966, by the inclusion in a single admin­
istrative 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 eco­
nomic 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, con­
servation of national resources, efficient marketing and distribution of farm-raised products, family living, 4-H club work, youth development, community improvement and resource de­
velopment.

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 appro­
priations.

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.

"Refresher" or service courses, which do not qualify for college credit, are conducted by Engineering Extension throughout the state or on campus. Level of instruction varies from vocational or "practical" to collegiate post-graduate.

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 for fire department officers, instructors or 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 containing implications which reach from the area of 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, 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 25,000 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.
Application for admission to Iowa State University may be made by writing to the Director of Admissions, 104 Bearshear 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, 104 Bearshear 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, 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 when enrolled in a summer session, or (4) be denied admission.

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

3. A graduate of a non-approved high school must submit all data as required above and in addition must take examinations which will demonstrate his general competence to do successful 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 original 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 (4.20 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 applicant 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 for the earning of the baccalaureate degree.

2. Students from non-accredited colleges. The University may refuse to recognize credit from a non-accredited 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 time of the validation process at the time of provisional admission. Each student from a non-accredited 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 NON-RESIDENT STUDENTS FOR ADMISSION AND FEE PURPOSES

1. General. Students enrolling at one of the three state institutions shall be classified as Resident or Non-Resident for admission fee, and student body 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, adoption, award of custody, or previous appointment of a guardian. The burden of establishing that a student is exempt from paying the non-resident fee is upon the student.

For purposes of resident and non-resident classifications, the word "parents" as herein used 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.

*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.
2. Residence for Tuition Purposes. Regulations regarding residence for admission, fee and tuition payment 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.

Domicile within the state means adoption of the state as a fixed permanent home and involves personal presence within the state. The two categories are discussed in more detail below.

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 Iowa shall be a non-resident 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.

A minor under legal guardianship shall not be granted resident status if the primary purpose of the guardianship is to qualify the minor for resident tuition. A minor living with and being supported by a relative or a friend who is a resident of Iowa, but not a minor's legal guardian, may be granted resident status if he has lived with the relative or friend for at least three years prior to high school graduation.

4. Students Over 21 Years of Age and Married Students Under 21 Years of Age. A resident student 21 years of age or over and 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 Iowa by living there for at least 12 consecutive months immediately preceding registration. Bona fide residence in Iowa means that the student is not in the state primarily to attend a college; that he is in the state for purposes other than to attempt to qualify for resident status.

Any non-resident student who reaches the age of 21 years or is married while under 21 years of age while a student at any school or college does not, in fact by virtue of that fact, attain residence in this state for admission or tuition payment purposes.

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, non-resident tuition will be charged in all cases until 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 non-residents for admission, fee and tuition purposes.

A student who willfully gives incorrect or misleading information to evade payment of the non-resident fees and tuition shall be subject to serious disciplinary action and must also pay the non-resident 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 non-resident to resident will not be made retrospective beyond the semester or session in which application for resident classification is made.

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 findings 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 Communications, 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.

**College of Home Economics**—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 Sciences and Humanities**—For the curricula in Sciences and Humanities, one and one-half units of algebra and one unit of geometry are required. Students who have not completed all of these courses may take geometry and third-semester algebra at Iowa State University. For the curriculum in Physical Education for Men one unit of algebra is required.

**College of Veterinary Medicine**—See Veterinary Medicine, Admission Requirements.

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. Unconditional admission to the Technical Institute may be granted to students who are not in the upper one-half of their graduating class.

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**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 toxoid inoculations, are also advised.

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**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.

**Summer Orientation**

To welcome students and parents to Iowa State, and to accomplish more thoroughly some of the orientation process which ordinarily marks 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 June 1 and Aug. 1. 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 this is 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.

During the orientation period, both students and parents are briefed by faculty members on matters of curriculum, study, and university life in general. Considerable time is spent
on answering individual questions. Visits are made to residence halls, classrooms and laboratories to inspect facilities. Tests are administered to students so they may be placed in class sections according to their abilities and aptitudes. Each student has a personal conference with an academic adviser to outline his program of study.

Fall Orientation

All new students, including transfer students, are required to attend the orientation which precedes the opening of the 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.

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 non-laboratory 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 P 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, 1968. 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>Non-resident</th>
</tr>
</thead>
<tbody>
<tr>
<td>Registration fee</td>
<td>$375</td>
<td>$375</td>
</tr>
<tr>
<td>Tuition</td>
<td></td>
<td>630</td>
</tr>
<tr>
<td>Board and room</td>
<td>810</td>
<td>810</td>
</tr>
<tr>
<td>Books, supplies and equipment (estimated)</td>
<td>120</td>
<td>120</td>
</tr>
<tr>
<td>Total</td>
<td>$1,305</td>
<td>$1,935</td>
</tr>
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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>Non-resident</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Undergraduate</td>
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</tr>
<tr>
<td>12 wks</td>
<td>$125</td>
<td>$135</td>
</tr>
<tr>
<td>11 wks</td>
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<td>35</td>
</tr>
<tr>
<td>1 wk</td>
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Light Classification

<table>
<thead>
<tr>
<th></th>
<th>Iowa Resident</th>
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</thead>
<tbody>
<tr>
<td>3 hrs.</td>
<td>$45</td>
<td>$55</td>
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<tr>
<td>4 hrs.</td>
<td>60</td>
<td>70</td>
</tr>
<tr>
<td>5 hrs.</td>
<td>75</td>
<td>85</td>
</tr>
<tr>
<td>6 hrs.</td>
<td>90</td>
<td>100</td>
</tr>
<tr>
<td>7 hrs.</td>
<td>105</td>
<td>115</td>
</tr>
<tr>
<td>8 hrs.</td>
<td>120</td>
<td>130</td>
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</tbody>
</table>
Audits—Same as light classification
Off-campus—Same as light classification
In absentia—Same as light classification

Interim Fee
1 hour ........................................ $18 ......... $32
2 hours ........................................ 36 ........... 64

<table>
<thead>
<tr>
<th>Service</th>
<th>Resident Undergraduate</th>
<th>Resident Graduate</th>
<th>Non-resident Undergraduate</th>
<th>Non-resident Graduate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lakeside Laboratory</td>
<td>$70</td>
<td>$70</td>
<td>$70</td>
<td>$70</td>
</tr>
<tr>
<td>Driver Education</td>
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<td>$20</td>
<td>$20</td>
<td>$20</td>
</tr>
<tr>
<td>Special Women’s Education</td>
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<td>$15</td>
<td>$20</td>
<td>$20</td>
</tr>
<tr>
<td>Change of Classification</td>
<td>$1</td>
<td>$1</td>
<td>$1</td>
<td>$1</td>
</tr>
</tbody>
</table>

Private Music Instruction

University students, per quarter
10 lessons per quarter 1 credit .................................. $30 .............. $33
20 lessons per quarter 2 credits .................................. 50 .............. 55
Electric Organ practice ........................................... 10 .............. 10
Pipe Organ practice ................................................ 15 .............. 15

Non-University students, per quarter
**SPECIAL STUDENTS AND NON-COLLEGIATE STUDENTS**

Special students and non-collegiate 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 $62. For either term of the summer quarter, the fee is $31.

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 non-refundable 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**

Non-resident 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 subscription to several student publications. An additional charge is made for admission to football and basketball games.

**SENIOR FEE**

To cover the cost of special senior activities, all students classified as seniors in the spring quarter pay a fee of $1 at that registration.

**REFUNDS**

Refunds are made on the unused portions of fees for registrations, 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.
The University provides housing facilities for approximately 2,900 single undergraduate women, 4,800 single undergraduate men, 1,350 married students, 272 single graduate men and 118 single graduate women. Chapter houses are maintained near the campus by 35 fraternities and 13 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, 1968, was $810.

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 1968 was $116 per quarter in a double room or $154 per quarter in a single room. A meal ticket may be purchased for $168 per quarter (as of September 1968) 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 500 permanent apartments in University Village for student families. Rates for these married student apartments as of September 1968 were $36 per month in Pammel Court, $75 per month in Hawthorn Court and $88 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, 1210 Friley Hall.

The single room rental rates average $9 per week; the double room rental rates average $7 each man 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 offers students and faculty access to study facilities and to collections on an open-shelf basis. The Library's collections number approximately 640,000 volumes, presently emphasizing the basic and applied fields of the biological and physical sciences, with additional holdings of 123,000 microtexts covering a wide range of academic areas. The Library is also developing rapidly growing collections to support degree programs in numerous disciplines in the socio-humanistic areas. Very complete holdings of periodicals are available in such fields as botany, chemistry, entomology, mathematics, physiology, physics, and veterinary medicine. At the present time the Library is receiving more than 12,000 periodicals and other serial publications in many languages, amounting to world coverage. The Library's collections are also strong in other subject fields which are emphasized in the areas of instruction and research.

Graduate students, as well as upperclassmen, majoring in chemistry and physics, have access to the Physical Sciences Reading Room which links the Chemistry and Physics buildings at the second floor level. The Engineering Reading Room, containing specialized publications in subject areas related to engineering, is located on the third floor of Marston Hall. There is a special collection of books in architecture in Engineering Annex, and also an Economics and Sociology Reading Room on the fourth floor of East Hall.

The Library encourages use of its collections, services, and study facilities. Both formal and informal library instruction in the use of books and libraries are offered to graduate and undergraduate students.

Exhibits of new books in various subjects are maintained on open-shelf display. Current numbers of selected periodicals are displayed in alcove browsing areas throughout the building.

STUDENT COUNSELING SERVICE
Roy E. Warman, Ph.D., Director

Ellen L. Betz, Ph.D.
Ronald D. Baker, Ph.D.
Martin O. Bielefed, Ph.D.
Russell J. Canute, Ed.D.
Eugene S. Cherry, Ph.D.
Martin F. Fritz, Ph.D.
Charles W. Jones, M.S.
Marianne L. McManus, Ph.D.
Daniel M. McMillen, Ph.D.
John W. Menne, Ph.D.
David H. Mills, Ph.D.
Charles A. Poe, Ph.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.
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 except that 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 is available on a voluntary basis and at a favorable rate to all students who are enrolled at the University for a minimum of nine credits per quarter.

**PLACEMENT OFFICES**

The University maintains offices in five different areas where employers and prospective employees are brought together. These areas are Agriculture, Engineering and Sciences, Home Economics, Teaching and Veterinary Medicine.

Each of these offices assists students who are about to graduate and who seek information about career openings in their field. The offices also work with alumni who are changing positions. In some instances, undergraduates are assisted in finding summer employment.

**OFFICE OF THE DEAN OF STUDENTS**

Eugene E. Robinson, Ph.D., Dean of Students
C. Arthur Sandeen, Ph.D., Associate Dean of Students
Paul R. McQuilkin, M.B.A., Assistant Dean of Students
Eugene L. Clubine, M.S., Coordinator, Foreign Student and Visitor Services
Maurice S. Kramer, M.S., Foreign Student Adviser
Lucien W. Hope, B.S., Assistant Foreign Student Adviser
Dorothy B. Foley, B.A., Assistant to Coordinator
Thomas G. Goodale, M.S., Assistant Dean and Coordinator of Orientation
Marlene M. Strathe, B.S., Acting Panhellenic Adviser
Edgar P. Swanson, M.S., Supervisor of Financial Aids
Ralph E. Stotts, M.S., Assistant Supervisor
Michael White, B.A., Assistant Supervisor
Thomas J. Budnik, M.S., Assistant Supervisor
Gerald Beckett, Assistant Supervisor

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 Ward System; 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.
Foreign Student and Visitors Services

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; is often involved 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.

Student Financial Aid

Student financial aids in the form of financial planning, direct grants, loans, scholarships and employment are available to students that have been admitted to Iowa State University. Detailed information may be found in the next section of this catalog.
A large number of Iowa State University students depend in part upon their own savings, current earnings, loans, scholarships or Educational Opportunity Grants for support in their university educational program. A combination of two or more of these resources often is used. Financial aid in various forms available to students in Military Science, Air Science and Naval Science is outlined in the sections which deal with each branch of the Armed Services. (See Index.)

The award of a scholarship, Educational Opportunity Grant or issuing of a loan is based on a careful review of the background and the needs of each individual applicant. Iowa State University uses the College Scholarship Service or American College Testing Service for needs analysis.

Detailed information may be obtained from the Student Financial Aid Office, 9 Beardshear Hall.

STUDENT AID FUNDS

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

HIGH SCHOLARSHIP RECOGNITION AWARDS

High school graduates in the upper one, two or three percent of their high school graduating class 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.

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 financial means of their own or of their families would be unable to obtain such benefits without such aid.

Students who feel they may qualify for such a grant should have their parents file a Parents Confidential Statement when they apply for admission to Iowa State University. Further information on these grants may be obtained from the high school counselor or by writing the Financial Aids Office, 9 Beardshear Hall, Iowa State University. Parents Confidential Statement blanks 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 Financial Aids Office, 9 Beardshear Hall. Most part-time employment of students on campus is found in the residence halls dining service, the University Library, Memorial Union, campus 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 at 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 are potentially eligible for employment by their colleges under federally supported Work-Study Programs.

Students may work up to 15 hours weekly while attending classes full time. During the summer or other vacation periods when they do not have classes, students may work full time (40 hours per week) under the program.

To work under this program, a student must be enrolled and be in good standing, or be accepted for enrollment as a full time student. The student's eligibility depends upon his need for employment to defray college expenses, with preference given to applicants from low-income families.

STUDENT LOAN FUNDS

Long term loans to be paid after graduation from the University are available through either the University or the new State Guaranteed Loan Program. Students in need of financial help are encouraged to apply the quarter previous to the time they will need help.

The amount loaned is determined by need, availability of funds and evaluation of scholastic ability. The National Defense Student Loan Program is being leveled off in favor of the new Guaranteed Loan.

Loans must be used for educational purposes, such as room, board, tuition, books, etc. Emergency loans are available at a modest charge. No advance application for these emergency loans is necessary, providing an individual's scholastic standing is satisfactory.

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 Financial Aid Office, 9 Beardshear Hall.

<table>
<thead>
<tr>
<th>Name of Fund</th>
<th>Date Started</th>
<th>Name of Fund</th>
<th>Date Started</th>
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<tbody>
<tr>
<td>John P. Baylor Memorial</td>
<td>1960</td>
<td>George I Miller</td>
<td>1931</td>
</tr>
<tr>
<td>William Braddock Memorial</td>
<td>1945</td>
<td>Monona County</td>
<td>1964</td>
</tr>
<tr>
<td>Mary Davidson Budge</td>
<td>1938</td>
<td>Joe S. Morrison Memorial</td>
<td>1938</td>
</tr>
<tr>
<td>Class of 1896</td>
<td>1947</td>
<td>Sophia Schott Morrison Memorial</td>
<td>1948</td>
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<tr>
<td>Class of 1913</td>
<td>1963</td>
<td>Martin Mortensen</td>
<td>1940</td>
</tr>
<tr>
<td>Julia Trueman Colpitts Memorial</td>
<td>1936</td>
<td>National Defense Student Loan Fund</td>
<td>1958</td>
</tr>
<tr>
<td>Blair Converse Memorial</td>
<td>1939</td>
<td>Raymond H. Neighbors</td>
<td>1968</td>
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<tr>
<td>A. C. Drach</td>
<td>1958</td>
<td>Henry Ness</td>
<td>1954</td>
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<tr>
<td>Jean Crowthers Earhart Memorial</td>
<td>1963</td>
<td>Hattie Miller Newens Memorial</td>
<td>1910</td>
</tr>
<tr>
<td>Earth Science</td>
<td>1965</td>
<td>Robert Paul Paxson Memorial</td>
<td>1964</td>
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<tr>
<td>Frank A. Easton</td>
<td>1964</td>
<td>W. Kiley Powers Memorial</td>
<td>1962</td>
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<tr>
<td>C. L. Fincham</td>
<td>1957</td>
<td>LaRue F Prior</td>
<td>1966</td>
</tr>
<tr>
<td>Forestry</td>
<td>1960</td>
<td>Quaker Oats</td>
<td>1928</td>
</tr>
<tr>
<td>Ella Gardner Memorial</td>
<td>1942</td>
<td>Richard L. Ratterree Memorial</td>
<td>1944</td>
</tr>
<tr>
<td>General Emergency Loan Fund</td>
<td>1933</td>
<td>Maria M. Roberts Memorial</td>
<td>1940</td>
</tr>
<tr>
<td>Joseph E Guthrie Memorial</td>
<td>1935</td>
<td>Rolston-Starr Memorial</td>
<td>1966</td>
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<tr>
<td>Hanscom and Edwards Memorial</td>
<td>1965</td>
<td>Ruggles Memorial</td>
<td>1944</td>
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<tr>
<td>Ike Hayes</td>
<td>1955</td>
<td>Joseph Schilling</td>
<td>1954</td>
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<tr>
<td>Health Professions Loan Fund</td>
<td>1967</td>
<td>Frances A Sheldon Memorial</td>
<td>1925</td>
</tr>
<tr>
<td>M. D. Helser</td>
<td>1958</td>
<td>Julia McCulloch Smith Memorial</td>
<td>1930</td>
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<tr>
<td>George O. Hendrickson Memorial</td>
<td>1964</td>
<td>George E Sokal Memorial</td>
<td>1936</td>
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<tr>
<td>Edward Hogeland</td>
<td>1965</td>
<td>Lowell O. Stewart Memorial</td>
<td>1959</td>
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<tr>
<td>Ella R. Hughes Memorial</td>
<td>1937</td>
<td>Paul Taylor Memorial</td>
<td>1958</td>
</tr>
<tr>
<td>Mary Huncke</td>
<td>1952</td>
<td>George W Tinsley</td>
<td>1965</td>
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<tr>
<td>Christian B. Jensen Memorial</td>
<td>1958</td>
<td>Undergraduate Student Loans</td>
<td>1951</td>
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<tr>
<td>Frances David Korf Memorial</td>
<td>1965</td>
<td>I.S U Veterinarian</td>
<td>1958</td>
</tr>
<tr>
<td>Guy M. Lambert</td>
<td>1951</td>
<td>National Association of Federal Veterinarians</td>
<td>1964</td>
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<tr>
<td>Max D. Levine</td>
<td>1964</td>
<td>Gordon Wallace Wattles Memorial</td>
<td>1912</td>
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<tr>
<td>D. O. McCoy</td>
<td>1964</td>
<td>Gaylord S. White Memorial</td>
<td>1957</td>
</tr>
<tr>
<td>G. B. McDonald</td>
<td>1960</td>
<td>Georgia White Memorial</td>
<td>1922</td>
</tr>
</tbody>
</table>
Guaranteed Student Loan Program

The Guaranteed Loan is a program of borrowing, primarily for students from middle or upper income families. Upon completion of his program, the student has an obligation to repay his loan with 7 percent interest.

If the student qualifies for interest subsidy, the full 7 percent interest will be paid by the Federal Government during the period of time in which the student is enrolled as full-time, and for nine months thereafter.

Health Professions Student Loan Program

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 in need.

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. No other formal application blank is necessary.

Most scholarships and grants are issued on the basis of need and scholarship, not scholarship alone. Parent's confidential statements are 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 possible local scholarships as well as National Merit Scholarship, National Science Talent Search Scholarship and others. A new student should also contact the Dean of the College of his choice at the University for further information about financial aid.

High school officials also can provide information about aids such as those available to war orphans and physically handicapped students.

Unless otherwise stated, inquiries should be directed to the Financial Aids Office, 9 Beardshear Hall.
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.

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, 9 Beardshear Hall.

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

1915 Scholarship for undergraduates at 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, 9 Beardshear Hall.

Silllik 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.

Ward Scholarships for Ward System freshmen and sophomores. Apply to Ward System, Memorial Union.
Alda 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 Journalism Department.

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 Journalism Department.

Journalism Tuition Scholarships for students majoring in journalism. Apply to Journalism Department.

William Kershner Scholarship for a student majoring in journalism. Apply to Journalism Department.

Minneapolis Tribune Scholarship for a senior in journalism.

Ruth Watkins Newton Scholarship for a journalism major. Apply to Journalism Department.

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

Texaco Scholarships for junior and senior men in a curriculum which qualifies them for a career in the petroleum industry. No application necessary.

Agricultural Scholarships

Applications for freshman scholarships must be submitted by March 1. Applications for sophomore, junior and senior scholarships are due either Oct. 15, or April 15 each year. 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.

Beef Cattle Improvement Scholarship for a student who has completed courses in animal breeding, beef production and a special problem on beef cattle improvement.

Borden Agricultural Award for the student with the highest grade average among students completing two or more dairy courses prior to senior year. 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 sophomores or juniors majoring in agronomy, entomology, horticulture or plant pathology. 4-H background required. Apply to State 4-H Office by Sept. 15.

Chicago Mercantile Exchange Scholarship for an Iowa freshman.

Chicago and North Western Railway 4-H Scholarship for male agricultural economics or forestry juniors, seniors or graduate students. 4-H background and essay necessary. Apply to state 4-H office by Sept. 15.
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Chicago Farmers’ Club Scholarship for a senior.
Cooperage Industries of America, Inc. Scholarship for a freshman in forestry.
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 Award for College Seniors. Made at the end of the junior year and includes a four week program at Camp Minniwanca and at the Ralston Purina facilities in St. Louis, Mo. No application necessary.

Danforth Leadership Training Scholarship for a freshman. This includes a program at Camp Minniwanca Leadership Training Camp. No application necessary.

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

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 communication.

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

Farm Journal Scholarship for a freshman in agricultural communications.

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 students having an interest in a career in agricultural 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 Mrs. Portia Goke.

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

George Gund Animal Science Awards for seniors in animal science. 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.

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 Hoo-Hoo Club Forestry Scholarship for a sophomore in forestry. 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 communication 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.

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.

National Plant Food Institute Scholarship for an agronomy sophomore who has been especially active in the Agronomy Club. No application necessary.

Poultry Industry Scholarships for freshmen 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 Senior Scholarship for a senior in agricultural business, animal, dairy or poultry science, agricultural communication, agronomy, farm operation or agricultural education. No application necessary.

Robert V. Rasmussen Scholarship for students enrolled in dairy husbandry.

Rice Estate Advanced Curriculum Scholarships for juniors and seniors taking the advanced curriculum.

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

Louis Rich Foods, Inc. Scholarship for undergraduates who have a strong interest in the turkey industry.

Ralph Rothacker Scholarship for juniors and seniors in landscape architecture with a grade point average of 2.35 and 2.65 in landscape architecture.

Spokesman Press Scholarship for an undergraduate or graduate in agricultural communication.

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.

IMC Louis Ware Prize for a senior planning graduate study. Sponsored by the International Minerals and Chemical Corporation.

H. K. Wilson Advanced Curriculum Scholarship for a sophomore who has earned a 3.0 cumulative average and plans to follow the advanced curriculum.

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

Engineering Scholarships

Applications for all College of Engineering scholarships, awards and aid funds must be made in triplicate by Jan. 30. Unless otherwise stated below, 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.

Archer-Daniels-Midland Company Scholarship for a senior in chemical 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, 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.

Wallace A. Cassell Memorial Scholarship for a junior in electrical engineering.

Caterpillar Tractor Company Scholarships for undergraduates in mechanical, electrical and civil engineering.

Continental Oil Company Scholarship for an undergraduate in chemical engineering.

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

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

Douglas Aircraft Company Scholarship for a senior in aerospace or electrical engineering.

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

Fisher Foundation Scholarships for undergraduates in mechanical or industrial engineering.

Almon H. Fuller Scholarship for a senior in civil 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 building construction 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 engineering, electrical engineering, industrial engineering, 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. Shirley Award Scholarship for undergraduates in civil engineering.

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

Texaco Oil Company Scholarship for a junior or senior in chemical, civil, electrical, industrial 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

Unless otherwise stated below, send applications to the Home Economics Scholarships and Awards Committee, 122 MacKay Hall.

Home Economics Alumnae Scholarships from the Alumni Achievement Funds for 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.

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

Bishop Buffets, 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 Company Four-year Scholarship for a high school senior planning to major in food and nutrition. Not available each year—given twice in 1962-1966; 1966-70. Company decides each time.

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 Award for Home Economics College senior. Apply junior year.

Danforth Leadership Training Scholarship for a home economics freshman.

Delta Phi Delta Scholarship for a student in applied art. Inquire at Applied Art Department, 216A 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 Technical Journalism Department.

Vera Foreman Friley Scholarship for a home economics senior.

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

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

Home Economics Council Award Scholarship for a student selected by the Home Economics Council.

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.

Millie Kalsem Award for a student in food and nutrition.

Catherine MacKay Scholarship for a home economics freshman.

Martha Moffit Scholarship for an undergraduate student in food and nutrition. 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.

Omicron Nu Award for a home economics senior who is a member of Omicron Nu. Apply to Omicron Nu, 122 MacKay Hall.

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

Phi Upsilon Omicron Scholarship for a sophomore or junior student in home economics.

Sears-Roebuck Foundation Scholarships for freshmen in home economics with 4-H records.

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.

Velshea Cherry Pie Scholarship 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, 9 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.

R.C.A.—N.B.C. Television Scholarship for a telecommunicative arts major. Apply to Professor in Charge, Telecommunicative Arts, 21 Exhibit Hall.

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

Veterinary Medicine Scholarships

All veterinary medicine award and scholarship recipients are selected, with the single exception of the Pfizer Award; therefore, no applications are necessary.

American Veterinary Medical Association Women's Auxiliary Award for a senior veterinary student based upon some creative activity.

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

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

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 for outstanding academic achievement in veterinary studies.

Charles Pfizer and Company Award for a junior in veterinary medicine. Selection is made from applications submitted by students in their junior year.

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.

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 third 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 direction of professionally trained persons.

Student religious groups are among the strongest of campus organizations.

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

The University Lecture Series brings to the campus during the academic year 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. The University Lecture Series, from time to time, also sponsors or co-sponsors dramatic, dance and musical events.

FOCUS

During the first few weeks of March each year the University features a fine arts festival called Focus. This program brings to the campus arts and crafts exhibits, musical, dance and dramatic events and lecturers prominent in their respective areas of the arts, as well as in the areas of national and international affairs.

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, as well as 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 private lessons for qualified students in both vocal and instrumental music as well as courses in music appreciation and history, theory, conducting and music education. Large student performing organizations include four choruses,
five bands, and a symphony orchestra. Smaller student ensembles include chamber orchestras, chamber singers and stage bands. Campus concerts, student operas, musical shows, concert tours to Iowa Cities 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.

In co-sponsorship with the Visual Instruction Service, the Theatre presents a series of 15 films which include unusual American films that are part of the history of films 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.

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, which is 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, 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 $3.5 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
- Alpha Lambda Delta
- Alpha Zeta
- Gamma Sigma Delta
- Omicron Nu
- Phi Eta Sigma
- Phi Kappa Phi
- Phi Zeta
- Sigma Xi
- Tau Beta Pi

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: official publication of the student chapter of the American Veterinary Medical Association
- The Iowa State University Veterinarian: published by students of the College of Engineering
- The Iowa Engineer: published by students of the College of Sciences and Humanities
- Ethos: publishes creative writing of students
- Sketch: publishes best writings of freshmen English students
- Three Quarters: student newspaper

FRATERNITIES AND SORORITIES

All social fraternities and sororities are under the supervision of the Dean of Students. His staff works through Interfraternity Council and Panhellenic Council to provide opportunities for self-development of students in these residence groups.

The 35 social fraternities with chapters at Iowa State provide living accommodations for approximately 1,800 men. The cost of living in a fraternity house varies from $251 to $340 per quarter, with an average cost of $300. This amount includes board, room, social dues and other chapter expenses. Initiation fees range from $20 to $117.50 per member with an average cost of $79. The higher fees generally include the cost of the fraternity pin. First-year men students may live in a fraternity house.

The 13 national social sororities provide living accommodations for approximately 650 women. The monthly house bill for each member of these chapters ranges from $91 to $110, with an average cost of approximately $93. This amount includes room, board, social and national dues, other chapter expenses, and in some cases the building fund payment. Initiation
fees vary from $40 to $85. The higher figure may include the cost of the active’s pin or “badge,” building fund payment and lifetime membership.

Freshman sorority pledges, enrolling fall quarter, are required to live in residence halls for one year and may move to their chapter houses at the beginning of their sophomore year. Upperclass women, who pledge during formal fall rush or during the school year, may move into their chapter houses only by complying with the provisions of their residence hall contracts.

To be eligible for pledging either a fraternity or a sorority and for participating in sorority 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.

MEN’S RESIDENCE ASSOCIATIONS

Students living in the Friley-Helser Complex are members of the Men’s Residence Association. The MRA includes 44 “houses” which are organized as units within the Friley and Helser residence halls. Each unit of 40 to 75 men elects its own officers, has its own program of social activities and competes in intramural athletics. The MRA has its own officers, social program, camera club, weight-lifters club, ham radio club and library. A student operated radio station (KISU) serves all of the residence halls.

Students living in Knapp Hall, Storms Hall, Wallace Hall or Wilson Hall are members of the Towers Residence Association. The TRA is the overall student government organization and is composed of the 10 separate living units, called “houses,” within each hall. The TRA elects its officers and develops its programs through the TRA Senate, its legislative body. Each house has 59 members and elects its own officers, has its own program of social activities and competes in intramural athletics.

WOMEN’S RESIDENCE ASSOCIATION

Women living in residence halls are members of the Women’s Residence Association. The WRA is organized into 42 living units, called “houses”. Each house elects its own officers and is responsible for the social activities, intramural sports and similar activities within the house. The Women’s Residence Association is the organization that unites and coordinates all the individual house governments in the Women’s Residence Halls.
ALUMNI ASSOCIATION

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

Those who have at some time been enrolled at Iowa State University are organized into an alumni group known as the Iowa State University Alumni Association. Students are urged to look forward to membership in the Association. Through it the alumnus is assured of enduring ties with his school and with his classmates.

The Alumni Association of Iowa State University was organized in 1878 to promote the highest interests of the institution and to increase friendship and understanding among students and alumni. It now serves more than 70,000 living alumni of record. The offices of the Association 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, appears bimonthly.

ALUMNI ACHIEVEMENT FUND

Donald F. Gustofson, B.S., Director

The Alumni Achievement Fund receives gifts from alumni, former students, industry and friends of the University.

It is a charitable corporation and all gifts to it are tax deductible. The Fund is administered by a board of 15 trustees appointed by the Alumni Association. The Board of Trustees governs its staff and policies.

The Alumni Achievement Fund receives annual gifts each year from thousands of friends and alumni. It is often the recipient of major gifts such as farms, stocks and securities and various trusts.

The purpose of the Alumni Achievement Fund is to support the many worthwhile causes for which other funds are not available. This includes such things as memorials, aid for needy students, music, research, campus organizations, awards for distinguished professors and many other demands that often arise as emergencies and are therefore unpredictable. One of the main strengths of the Alumni Achievement Fund is its flexibility.

THE IOWA STATE UNIVERSITY FOUNDATION

Richard A. Morton, B.S., 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 73 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. However, a student may be admitted with a quality point deficiency but will be required to earn sufficient 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 upon registration at Iowa State to submit a transcript or transcripts of all work taken elsewhere. 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, 9 of this 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" are not subject to the English proficiency requirement. Students whose native language is something other than English also do not come under this 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 three 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  C  2 points  F  0 points
B  3 points  D  1 point  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.

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 to the Committee on Student Conduct the authority to establish policy and to deal directly with discipline cases.

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.
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 three broad areas (1) research and education, (2) agricultural production, or (3) business and industry. Several curricula provide minors or options so that the specialization developed in the curriculum is designed for entry in one of these three 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 recreation programs which often require agricultural knowledge.

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 four-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 Math. 101 may be substituted for physical sciences.
IV. Biological Sciences
   (Bacteriology, biochemistry, biophysics, botany, genetics, zoology)
V. Social Sciences
   (Economics, government, psychology, sociology)
VI. Humanities
   (Art, history, literature, music, philosophy)

Credits Required
11  8  16  10  12  6

Most undergraduate study in the College of Agriculture covers a period of four 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 this catalog.
Curricula in Agriculture

Leading to the Degree Bachelor of Science

<table>
<thead>
<tr>
<th>Curriculum or Major</th>
<th>Department</th>
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<tbody>
<tr>
<td>Agricultural Business</td>
<td>Economics</td>
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<td>Agricultural Climatology</td>
<td>Agronomy</td>
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<td>Agricultural Communication</td>
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<td>Agricultural Education</td>
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<td>Business</td>
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<td>Agricultural Engineering</td>
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<td>Agronomy</td>
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<td>Animal Science</td>
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<td>Crop Science</td>
<td>Animal Science</td>
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<tr>
<td>Dairy Science</td>
<td>Zoology and Entomology</td>
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<tr>
<td>Entomology</td>
<td>Animal Science</td>
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<tr>
<td>Farm Operation</td>
<td>College of Agriculture</td>
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<tr>
<td>Fisheries and Wildlife Biology</td>
<td>Zoology and Entomology</td>
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<td>Food Technology</td>
<td>Dairy and Food Industry</td>
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<td>Forestry</td>
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<td>Forest Products</td>
<td>Landscape Architecture</td>
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<tr>
<td>Horticulture</td>
<td>Agronomy</td>
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<tr>
<td>Landscape Architecture</td>
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<tr>
<td>Plant Pathology</td>
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<tr>
<td>Poultry Science</td>
<td>Agronomy</td>
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<tr>
<td>Public Service and Administration in Agriculture</td>
<td>Sociology and Anthropology</td>
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<td>Resource Development for Outdoor Recreation</td>
<td>College of Agriculture</td>
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<td>Soil Science</td>
<td>Agronomy</td>
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<tr>
<td>Urban Planning</td>
<td>Landscape Architecture</td>
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</tbody>
</table>

Leading to the Diploma Associate in Agriculture

A two-year Technical Institute 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 three credits of physical education.

The student who decides to terminate his study after completion of 96 credits has above a 1.75 grade average and meets requirements similar to the first two years of a four-year program, may be awarded a two-year certificate in agriculture.

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 selected must be 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 Communication: 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 Technical Journalism.

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

#### FALL QUARTER

<table>
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<tr>
<th>Course</th>
<th>Credits</th>
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<td>Agricultural Economics</td>
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<td>General Chemistry</td>
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<tr>
<td>Algebra and Trigonometry</td>
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<td>Orientation in Agricultural Business</td>
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<tr>
<td>Principles of Biology</td>
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<td>Library Instruction</td>
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<td>Physical Education</td>
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#### WINTER QUARTER

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<td>Principles of Crop Science</td>
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<tr>
<td>General Chemistry</td>
<td>4</td>
</tr>
<tr>
<td>Biology of Organisms</td>
<td>2</td>
</tr>
<tr>
<td>Language in Composition and Reading</td>
<td>4</td>
</tr>
<tr>
<td>Physical Education</td>
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</tbody>
</table>

#### SPRING QUARTER

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Animal Production</td>
<td>5</td>
</tr>
<tr>
<td>Introduction to Sociology</td>
<td>4</td>
</tr>
<tr>
<td>Rural Sociology</td>
<td>3-4</td>
</tr>
<tr>
<td>Physical Science</td>
<td>2</td>
</tr>
<tr>
<td>Mathematics elective'</td>
<td>5</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>American Government</td>
<td>3</td>
</tr>
<tr>
<td>General Psychology</td>
<td>3</td>
</tr>
<tr>
<td>Principles of Economics</td>
<td>3</td>
</tr>
<tr>
<td>Principles of Statistics</td>
<td>3</td>
</tr>
<tr>
<td>Psychology of Sales</td>
<td>3</td>
</tr>
<tr>
<td>Fundamentals of Speech</td>
<td>3</td>
</tr>
</tbody>
</table>

#### Junior Year

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Price and Resource Allocation</td>
<td>3</td>
</tr>
<tr>
<td>Agricultural Law</td>
<td>3</td>
</tr>
<tr>
<td>Business Law I</td>
<td>3</td>
</tr>
<tr>
<td>Accounting II</td>
<td>3</td>
</tr>
<tr>
<td>Animal Nutrition</td>
<td>3</td>
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#### Senior Year

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Business Correspondence</td>
<td>3</td>
</tr>
<tr>
<td>Writing of Reports and Technical Papers</td>
<td>2-3</td>
</tr>
</tbody>
</table>

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Students are placed in Chem 101, 101A or 102A and Math 101B, 101, 103 or 110 consistent with preparation.

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 (six months of work experience). Students electing ROTC may apply these credits toward elective requirements.
Curriculum in Agricultural Communication

Administered by the Department of Journalism and Mass Communication.

Leading to the degree Bachelor of Science. Total credits required, 198, including three credits of physical education and professional work requirements.

Group Requirements

As a prerequisite to graduation, to insure breadth of educational experience, and to provide professional competence in the field of journalism or as foundation for graduate work, each student must complete, at some time during the four years, credits in the basic areas of learning as specified below.

1 Written and spoken English 17 credits  Must include Engl 104, 105, Sp 211
2 Mathematics, or mathematics and statistics 9 credits.
3. Chemistry, physics, earth science 16 credits Chem 101, 102
4 Biological sciences 10 credits Biol 101
5. Agricultural sciences 18 credits Agron 154A, An. S. 218
6 Social sciences and humanities 24 credits Pol S 215, Econ 241, 242, Hist 324
7 Foreign language 8 credits.
8. Journalism 34 credits T. Jl. 101, 201, 202, 203, plus at least four 300-level and three 400-level courses
9 Area of concentration in agriculture and related subject matter. 15 credits.
10 Other required courses 10 credits Three credits in physical education Lib 206, 1 credit T Jl. 490J, professional work requirement, 6 credits. Involves three months of full-time experience, or equivalent, in professional mass communication work
11 Electives 37 credits.

General Requirements

1 Freshman year During this year the student should complete eight credits in written English (Group 1) and at least four credits in mathematics (Group 2), 101 in Group 3 and at least 30 hours in Groups 3, 4, 5, or 6 with more than one group represented.
2 Sophomore year In the sophomore year, or first year of transfer, the student is expected to complete at least the 201 and 202 courses in journalism.
3 Junior and senior years Completion of group requirements remaining. Completion of journalism major and area of concentration Electives Students electing ROTC may apply these credits toward elective requirements. Fulfillment of the professional work requirement (T. Jl. 490J).

1 Students must enroll in a minimum of six hours in each of the animal and plant science areas
2 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.

Curriculum in Agricultural Education

With options in teaching and business.

Leading to the degree Bachelor of Science. Total credits required, 192, including three 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.
### Teaching Option

<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>Freshman Year</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Language in Composition and Reading</td>
<td>Engl 104</td>
<td>4</td>
<td>Language in Composition and Reading</td>
<td>Engl 105</td>
<td>4</td>
</tr>
<tr>
<td>Algebra and Trigonometry</td>
<td>Math 101B</td>
<td>3</td>
<td>Animal Production</td>
<td>An S 114</td>
<td>5</td>
</tr>
<tr>
<td>Principles of Crop Science</td>
<td>Agron 114A</td>
<td>4</td>
<td>Algebra and Trigonometry</td>
<td>Math 101C</td>
<td>2</td>
</tr>
<tr>
<td>Principles of Biology</td>
<td>Biol 101</td>
<td>3</td>
<td>Drafting for Agricultural Students</td>
<td>1 Ed 120</td>
<td>3</td>
</tr>
<tr>
<td>Biology of Organisms</td>
<td>Biol 102A</td>
<td>2</td>
<td>Physical Education</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Library Instruction</td>
<td>Lib 206</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Physical Education</td>
<td></td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| **Sophomore Year** | | | | | |
| Principles of Economics | Econ 241 | 3 | Principles of Economics | Econ 242 | 3 |
| General Chemistry | Chem 101 | 4 | General Chemistry | Chem 102 | 4 |
| Weed Identification and Control | Bot 216 | 4 | Fundamentals of Soil Science | Agron 154A | 4 |
| Metal Construction and Maintenance | A E 254 | 3 | Developmental Psychology | Psych 230 | 3 |
| Meat Animal Evaluation | An S 271 | 3 | | | |

| **Junior and Senior Years** | | | | | |
| Technical Agriculture | | | | | |
| A E 334 | 4 | Electives in physical science | | 3 |
| A E 415 | 3 | Gen 301 | | 3 |
| Agron 354 | 4 | Psych 333 | | 3 |
| An S 318 | 4 | Educ 305A | | 3 |
| An S 319 | 3 | Educ 305B | | 1 |
| Po S 365 | 3 | Ag Ed 321 | | 3 |
| A E 329 | 3 | Ag Ed 423 | | 3 |
| Econ 330 | 4 | Ag Ed 424 | | 3 |
| Econ 335 | 3 | Ag Ed 425 | | 3 |
| Electives in technical agriculture | 15 | Electives | Agricultural or nonagricultural | 10 |

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.
Business Option

This option is available to those students who do not wish to meet the requirements for a teaching certificate, but are preparing for agricultural education positions with business and industry. Students in this program may elect 17 credits in the following courses in place of Ag. Ed. 423, 424 and 425:

<table>
<thead>
<tr>
<th>Credits</th>
<th>Credits</th>
</tr>
</thead>
</table>
| Marketing Business Operations | \begin{align*} 
\text{Econ} & 292 \\ \text{Industrial Marketing I} & 3 \\
\text{Business Correspondence} & 2 \\
\text{Business Law I} & 3 \\
\text{Accounting I} & 4 \\
\end{align*} |
| Psychology of Sales and Advertising | \begin{align*} 
\text{Psych} & 250 \\ \text{Business and Professional Speaking} & 3 \\
\text{Persuasion} & 3 \\
\text{Advertising} & 3 \\
\end{align*} |

Curriculum in Agronomy

Agronomy at Iowa State University, at both the undergraduate and graduate level, encompasses the fields of soils, crops and climatology.

The undergraduate student elects one of four majors leading to the degree of Bachelor of Science: general agronomy, soil science, crop science or climatology. Total credits required, 192 including three credits of physical education.

Below is a typical freshman year program for all majors in agronomy:

<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>Principles of Crop Science</td>
<td>Algebra and Trigonometry</td>
<td>Fundamentals of Soil Science</td>
</tr>
<tr>
<td>Agron 114A</td>
<td>Math 101 (5 cr)</td>
<td>Agron 154A</td>
</tr>
<tr>
<td>Orientation</td>
<td>or</td>
<td>Principles of Biology</td>
</tr>
<tr>
<td>Agron 110</td>
<td>Finite Mathematics</td>
<td>Biol 101, 101A</td>
</tr>
<tr>
<td>Language in Composition and Reading</td>
<td>Math 104 (5 cr)</td>
<td>General Psychology</td>
</tr>
<tr>
<td>Engl 104</td>
<td>Language in Composition and Reading</td>
<td>Psych 101</td>
</tr>
<tr>
<td>Introduction to Geology</td>
<td>Engl 105</td>
<td>Principles of Statistics</td>
</tr>
<tr>
<td>Geol 100</td>
<td>General Chemistry</td>
<td>Stat 201A (3 cr)</td>
</tr>
<tr>
<td>General Chemistry</td>
<td>Chem 102</td>
<td>or</td>
</tr>
<tr>
<td>Chem 101 or 101A</td>
<td>Physical Education</td>
<td>Stat 201A (5 cr)</td>
</tr>
<tr>
<td>Physical Education</td>
<td>1</td>
<td>3-5</td>
</tr>
<tr>
<td>Library Instruction</td>
<td>Physical Education</td>
<td>1</td>
</tr>
<tr>
<td>Lib 206</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Physical Education</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

Courses selected should be consistent with high school preparation, and/or major elected. In addition to the courses listed, Ag 104 (six months of work experience) must be included prior to the senior year. Students electing ROTC may apply these credits toward elective requirements.

Core Requirements Common to All Majors

**Agronomic Sciences:** Agron 114A, 154A, 206, 310, 315, 354, 411, 415, 451 (25 credits)

**Biological Sciences:** Biol. 101, 101A, 102B, 107, 300, Bot 407, Gen 301 (26 credits)

**Physical Sciences:** Chem 101, 102, Geol 100, Phys 111 (15 credits)

**Social Sciences and Humanities:** Econ. 241, 242; Pol. S. 215; Psych. 101, Soc. 134, six elective credits in the humanities. One year of foreign language recommended but not required (21 credits).
Written and Spoken English: Engl. 104, 105, Lib 206, Sp 211, T JI 225 (15 credits).

Mathematics and Statistics: Select one in each group consistent with preparation Math 101, 103, 104 or 110, Stat. 201A or 201 (8 - 10 credits)

### Core Requirements Specific to Each Major

#### General Agronomy

<table>
<thead>
<tr>
<th>General Agronomy</th>
<th>Crop Science</th>
<th>Soil Science</th>
<th>Climatology</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agron 212</td>
<td>Agron 406</td>
<td>Agron 444</td>
<td>Agron 406</td>
</tr>
<tr>
<td>Agron 424</td>
<td>Agron 424</td>
<td>Agron 457</td>
<td>Agron 483</td>
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<td>Agron 444</td>
<td>Agron 444</td>
<td>Agron 464</td>
<td>Agron 483</td>
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<tr>
<td>Agron 453</td>
<td>Agron 473</td>
<td>Agron 473</td>
<td>Chem 103</td>
</tr>
<tr>
<td>Agron 464</td>
<td>Agron 485</td>
<td>Agron 473</td>
<td>Chem 211</td>
</tr>
<tr>
<td>Agron 473</td>
<td>B &amp; B 301</td>
<td>B &amp; B 301</td>
<td>Mteor 207</td>
</tr>
<tr>
<td>Agron 485</td>
<td>or</td>
<td>or</td>
<td>Mteor 441</td>
</tr>
<tr>
<td>An S 114</td>
<td>An S 318</td>
<td>Chem 103</td>
<td>Mteor 444</td>
</tr>
<tr>
<td>An S 318</td>
<td>Chem 211</td>
<td>Chem 211</td>
<td>Mteor 442</td>
</tr>
<tr>
<td>An S 319</td>
<td>Chem 334</td>
<td>Chem 334</td>
<td></td>
</tr>
<tr>
<td>Bot 216</td>
<td>Chem 335</td>
<td>Chem 335</td>
<td></td>
</tr>
<tr>
<td>Chem 231</td>
<td>Math 103</td>
<td>Math 103</td>
<td></td>
</tr>
<tr>
<td>Zool. 376</td>
<td>Math 110</td>
<td>Math 110</td>
<td></td>
</tr>
<tr>
<td>Bot 310</td>
<td>Phys 112</td>
<td>Phys 112</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Zool 376</td>
<td>Phys 113</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Com S 214</td>
<td>Com S 214</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Bot 320</td>
<td>Bot 310</td>
<td></td>
</tr>
</tbody>
</table>

#### Minors

In addition to the major, agronomy students may declare one or two minors. Students declaring one minor must include 20 hours of approved credits in that minor. Students declaring two minors must include at least 15 hours of approved credits in each minor. These minors can be either specific or general, or combinations of the two. Declaration of minors must be made prior to the completion of 140 credits.

Specific minors are those taken outside the department but within a department offering a major. General minors provide specialization in areas related to agronomy. Courses suggested for certain general minors are as follows:

**Selected General Minors** (Select 15 to 20 credits from the suggested courses in each minor)


**Business:** Econ 305, 314, 330, 335, 434, 435, 451, I Ad. 354, 384, 385, I E 354, Sp 334A

**Extension Education:** Educ 305, 468, Engl 404, Hort 214, 224B; Sp 334A

**Fertilizer Technology:** Agron 413, Econ 292, 305, 307, 308, 330, 430, 447, I E 351, Psych 250, Sp 334A

**International Service:** (See Index, International Service, of this catalog) Add to this the following Agron 415, Econ 411, Sp 334A

**Physical Science:** B & B 301 or 404, 405, Chem 321, 322, 323 or 483, 484, Phys 112, 113 or 221, 222, 223, Sp 334A

**Seed Technology:** Agron 413, Bot 306, 338, 404, 438, Econ 292, 330, Hort 164, 214, I E 351, Sp 334A

**Soil Conservation:** A E 306 or C E 211A, Agron 565, 575, Econ 330, 430, 434, 440, 510, Sp 334A

**Turfgrass Management:** Agron 314, 413, Bot 356, 426, For 460, Hort 214, 244A, 305, 316, 490, L A 210, 231, Sp 334A
Graduate Study Preparation

Agricultural Climatology: Math 213, Phys 113 or 223. Those interested in air pollution should take B & B 301, Chem 334 and 335.


Soil Science: Agron 557, Chem 321, 322, 323 or 336, 483, 484, Geol 351 and 352 or 381 and 431, Math 112.

Curriculum in Animal Science

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

The student who decides to terminate his study after completion of 96 credits, has above a 1.75 grade average, and meets requirements similar to the first two years of a four-year program, may be awarded a two-year certificate in agriculture.

Students interested in preparing for admission to the College of Veterinary Medicine may do so by fulfilling the requirements for admission stated in this catalog. (See Index, Veterinary Medicine.)

In addition to the animal science major, 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, including additional courses in biochemistry, biophysics, chemistry, mathematics, physics, statistics.
- Business, including additional courses in economics, industrial administration, psychology, speech.
- Communications, including additional courses in English, speech, technical journalism, telecommunicative arts.
- Education, including additional courses in education, psychology, sociology.
- Extension Service Training, including additional courses in agricultural education, psychology, sociology.
- International Service, including additional courses in anthropology, economics, foreign languages, political science, sociology.
- Plant Sciences, including additional courses in agronomy, botany, horticulture, plant pathology.

Core Requirements

<table>
<thead>
<tr>
<th>FALL QUARTER</th>
<th>WINTER QUARTER</th>
<th>SPRING QUARTER</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Orientation</strong></td>
<td>Language in Composition and Reading</td>
<td>Language in Composition and Reading</td>
</tr>
<tr>
<td>An. S. 110</td>
<td>Engl 104</td>
<td>Engl 105</td>
</tr>
<tr>
<td>Animal Production</td>
<td>General Chemistry</td>
<td>General Chemistry</td>
</tr>
<tr>
<td>An. S. 114</td>
<td>Chem 101</td>
<td>Chem 102</td>
</tr>
<tr>
<td>Mathematics</td>
<td>Principles of Statistics</td>
<td>Principles of Crop Science</td>
</tr>
<tr>
<td>Biol. 101, 101A</td>
<td>Stat 201</td>
<td>Agron 114A</td>
</tr>
<tr>
<td>Principles of Biology</td>
<td>Practical Experience</td>
<td>Meat and Meat Processing</td>
</tr>
<tr>
<td>Lib. 206</td>
<td>Ag. 104</td>
<td>An. S. 170</td>
</tr>
<tr>
<td>Library Instruction</td>
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<td>Physical Education</td>
</tr>
<tr>
<td>Physical Education</td>
<td>Physical Education</td>
<td>1</td>
</tr>
<tr>
<td>FALL QUARTER</td>
<td>WINTER QUARTER</td>
<td>SPRING QUARTER</td>
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<tr>
<td>----------------------</td>
<td>-------------------------</td>
<td>-------------------------</td>
</tr>
<tr>
<td></td>
<td>Credits</td>
<td>Credits</td>
</tr>
<tr>
<td><strong>Sophomore Year</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anatomy of Domestic</td>
<td>Principles of Economics</td>
<td>Principles of Economics</td>
</tr>
<tr>
<td>Animals V. An. 217</td>
<td>Econ. 241</td>
<td>Econ. 242</td>
</tr>
<tr>
<td>(3 cr ) or</td>
<td>Physiology of Domestic</td>
<td>Dairy Cattle Performance</td>
</tr>
<tr>
<td></td>
<td>Animals V. Phy 264</td>
<td></td>
</tr>
<tr>
<td>Comparative Anatomy</td>
<td>Ecology and Appreciation</td>
<td>Fundamentals of Speech</td>
</tr>
<tr>
<td>Zool. 224 (4 cr )</td>
<td>of Meat Animal Breeds</td>
<td>Sp 211</td>
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<tr>
<td></td>
<td>An S 214</td>
<td></td>
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<tr>
<td>Fundamentals of Soil</td>
<td>Elementary Organic</td>
<td>Publicity and Public</td>
</tr>
<tr>
<td>Science Agron. 154A</td>
<td>Chemistry Chem 231</td>
<td>Relations T JI 225</td>
</tr>
<tr>
<td>Meat Animal Evaluation</td>
<td>(5 cr .)</td>
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</tr>
<tr>
<td>An. S. 271</td>
<td>or</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Organic Chemistry Chem</td>
<td>American Government</td>
</tr>
<tr>
<td></td>
<td>334 (3 cr )</td>
<td>Pol S 215</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Junior Year</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fundamentals of</td>
<td>Applied Animal Nutrition</td>
<td>General Bacteriology</td>
</tr>
<tr>
<td>Nutrition An. S 318</td>
<td>An S 319</td>
<td>Biol 300 (3 cr .)</td>
</tr>
<tr>
<td>Introduction to</td>
<td>Principles of Animal</td>
<td>or</td>
</tr>
<tr>
<td>Genetics Gen. 301</td>
<td>Breeding An S 350</td>
<td>Bact 304 (5 cr .)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3-5</td>
</tr>
<tr>
<td></td>
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</tbody>
</table>

In addition to the courses in the core, each student is required to complete 12 credits of 400 level courses in animal science. These may not include 475 or 4900, and only three credits of 490A, B, and C.

- English and/or Speech 6 credits
- Humanities 6 credits
- Physical Science 3 credits
- Social Science 9 credits

Students electing ROTC may apply these credits toward elective requirements.

1Course selected should be consistent with preparation.

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**Curriculum in Dairy Science**

Administered by the Department of Animal Science.

Leading to the degree Bachelor of Science. Total credits required 192 including three credits of physical education.

The student who decides to terminate his study after completion of 96 credits has above a 1.75 grade average and meets requirements similar to the first two years of a four-year program, may be awarded a two-year certificate in agriculture.

Students interested in preparing for admission to the College of Veterinary Medicine may do so by fulfilling the requirements for admission stated in this catalog. (See Index, Veterinary Medicine.)

**Basic Science**, including additional courses in biochemistry, biophysics, chemistry, mathematics, physics.

**Business**, including additional courses in economics, industrial administration, psychology, speech.
Communications, including additional courses in English, speech, technical journalism, telecommunicative arts.

Education, including additional courses in education, psychology, sociology.

Extension Service Training, including additional courses in agricultural education, psychology, sociology.

International Service, including additional courses in anthropology, economics, foreign languages, political science, sociology.

Plant Sciences, including additional courses in agronomy, botany, horticulture, plant pathology.

For the dairy science major all students have the following core requirements:

<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>Orientation</td>
<td>R</td>
<td>General Chemistry</td>
<td>R</td>
<td>General Chemistry</td>
<td>4</td>
</tr>
<tr>
<td>An S 110</td>
<td></td>
<td>Chem 101</td>
<td></td>
<td>Chem 102</td>
<td></td>
</tr>
<tr>
<td>Animal Production</td>
<td>5</td>
<td>Introductory Food Technology</td>
<td>4</td>
<td>Principles of Crop Science</td>
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<tr>
<td>An S 114</td>
<td></td>
<td>D F I 114</td>
<td></td>
<td>Agron. 114A</td>
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<tr>
<td>Language in Composition and Reading</td>
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<td>4</td>
<td>Meat and Meat Processing</td>
<td>3</td>
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<tr>
<td>Engl 104</td>
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<td>Engl 105</td>
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<td>An S 170</td>
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<tr>
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<td>Practical Experience</td>
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<tr>
<td>Lib 206</td>
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<td>Ag 104</td>
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<tr>
<td>Physical Education</td>
<td></td>
<td></td>
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<tr>
<td>Dairy Cattle Performance</td>
<td>3</td>
<td>Ecology and Appreciation of Meat</td>
<td>3</td>
<td>Fundamentals of Soil Science</td>
<td>4</td>
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<tr>
<td>An S 235</td>
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<td>Animal Breeds</td>
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<td>Agron. 154A</td>
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</tr>
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<td>Elementary Organic Chemistry</td>
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<td>Principles of Economics</td>
<td>3</td>
<td>Publicity and Public Relations</td>
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<tr>
<td>Chem 231 (5 cr )</td>
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<td>Econ 242</td>
<td></td>
<td>T JI 225</td>
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<tr>
<td>or Organic Chemistry</td>
<td>3</td>
<td>Physiology of Domestic Animals</td>
<td>3</td>
<td>Introduction to Genetics</td>
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<tr>
<td>Chem 334' (3 cr )</td>
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<td>V Phy 264</td>
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<td>Gen 301</td>
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<td>Principles of Economics</td>
<td>3</td>
<td>General Psychology</td>
<td>3</td>
<td>Meat Animal Evaluation</td>
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</tr>
<tr>
<td>Econ 241</td>
<td></td>
<td>Psych 101 (3 cr )</td>
<td></td>
<td>An S 271</td>
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<td>Anatomy of Domestic Animals</td>
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<td>or Introduction to Sociology</td>
<td>3</td>
<td>Fundamentals of Speech</td>
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<tr>
<td>V. An. 217 (3 cr.)</td>
<td></td>
<td>Soc 134 (3 cr )</td>
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<td>Sp. 211</td>
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<tr>
<td>or Comparative Anatomy</td>
<td>3-4</td>
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<tr>
<td>Zool 224 (4 cr )</td>
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<td>An S 319</td>
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<td>An. S. 351</td>
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<td>American Government</td>
<td>3</td>
<td>Principles of Animal Breeding</td>
<td>3</td>
<td>General Bacteriology</td>
<td>3</td>
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<tr>
<td>Pol. S 215</td>
<td></td>
<td>An S 350</td>
<td></td>
<td>Biol 300 (3 cr )</td>
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<td></td>
<td></td>
<td>or Bact 304 (5 cr )</td>
<td>3-5</td>
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### College of Agriculture

**Senior Year**

<table>
<thead>
<tr>
<th>Course Title</th>
<th>Fall Quarter</th>
<th>Winter Quarter</th>
<th>Spring Quarter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Milk Production and Herd Management</td>
<td>3</td>
<td>An. S. 436</td>
<td>3</td>
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<tr>
<td>Milk Secretion</td>
<td>3</td>
<td>Humanities</td>
<td>6</td>
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</table>

Required are six credits in the humanities; at least three additional credits in physical sciences, and six additional credits in English and/or speech. Students electing ROTC may apply these credits toward elective requirements.

1Course selected should be consistent with preparation
2Chem. 103 is prerequisite.
3Humanities include art, history, literature, music or philosophy.

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### Curriculum in Entomology

Administered by the Department of Zoology and Entomology. Leading to the degree Bachelor of Science. Total credits required, 192, including three credits of physical education.

<table>
<thead>
<tr>
<th>Course Title</th>
<th>Fall Quarter</th>
<th>Winter Quarter</th>
<th>Spring Quarter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Principles of Biology</td>
<td>3</td>
<td>Environmental Biology</td>
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<tr>
<td>Biol. 101</td>
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<td>Biol. 103</td>
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<tr>
<td>Laboratory in Principles of Biology</td>
<td>2</td>
<td>General Chemistry</td>
<td>4</td>
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<tr>
<td>Biol. 101A</td>
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<td>Chem. 102</td>
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<tr>
<td>General Chemistry</td>
<td>4</td>
<td>Language in Composition and Reading</td>
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<tr>
<td>Chem. 101</td>
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<td>Engl. 104</td>
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<tr>
<td>Precalculus Mathematics</td>
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</tr>
<tr>
<td>Math 103 (5 cr.)</td>
<td></td>
<td>Principles of Statistics Stat 201</td>
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<tr>
<td>or Finite Mathematics</td>
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<tr>
<td>Math 104 (5 cr.)</td>
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<td>Library Instruction</td>
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<td>Lib. 206</td>
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<tr>
<td>Technical Lecture</td>
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<tr>
<td>Zool. 100</td>
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</table>

**Freshman Year**

**Sophomore Year**

<table>
<thead>
<tr>
<th>Course Title</th>
<th>Fall Quarter</th>
<th>Winter Quarter</th>
<th>Spring Quarter</th>
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</thead>
<tbody>
<tr>
<td>Elementary Organic Chemistry</td>
<td>5</td>
<td>Principles of Crop Science</td>
<td>4</td>
</tr>
<tr>
<td>Chem. 231</td>
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<td>Agron. 114A</td>
<td></td>
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<tr>
<td>Computer Organization and Programming</td>
<td>3</td>
<td>Principles of Economics</td>
<td>3</td>
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<td>Com. S. 214</td>
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<tr>
<td>Introduction to Literature</td>
<td>3</td>
<td>Comparative Anatomy</td>
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<td>Engl. 201</td>
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<td>Zool. 224</td>
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<td>General Entomology</td>
<td>4</td>
<td>Fundamentals of Soil Science</td>
<td>3</td>
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<tr>
<td>Zool. 274</td>
<td></td>
<td>Agron. 154A</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>Principles of Economics</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>Econ. 242</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>Introduction to Geology</td>
<td></td>
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<td></td>
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<td>Geol. 100</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>Introduction to Sociology</td>
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<td></td>
<td></td>
<td>Soc. 134</td>
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<tr>
<td></td>
<td>FALL QUARTER</td>
<td>WINTER QUARTER</td>
<td>SPRING QUARTER</td>
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</tr>
<tr>
<td><strong>Junior Year</strong></td>
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<tr>
<td>Principles of Horticulture</td>
<td>Hort. 114A</td>
<td>General Physics</td>
<td>Plant Taxonomy</td>
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<tr>
<td>Hort. 114A</td>
<td>3</td>
<td>Phys. 112</td>
<td>4</td>
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<tr>
<td>General Physics</td>
<td>4</td>
<td>Vertebrate Embryology</td>
<td>Fundamentals of Speech</td>
</tr>
<tr>
<td>Phys. 111</td>
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<td>Zool. 234</td>
<td>5</td>
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<tr>
<td>Principles of Physiology</td>
<td>4</td>
<td>Economic Entomology</td>
<td>Invertebrate Zoology</td>
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<td>Zool. 355</td>
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<td>Zool. 470</td>
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<tr>
<td><strong>Senior Year</strong></td>
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<td></td>
<td></td>
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<tr>
<td>Introductory Genetics</td>
<td>Gen. 301</td>
<td>General Bacteriology</td>
<td>Writing of Reports and Technical Papers</td>
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<tr>
<td>3</td>
<td>Bact. 300</td>
<td>3</td>
<td>Engl. 414</td>
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<td>American Government</td>
<td>Pol. S. 215</td>
<td>Elementary Plant Physiology</td>
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<tr>
<td>3</td>
<td>Bot. 310</td>
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</tbody>
</table>

Ag. 104, six months of work experience, is required before graduation.
A minimum of 12 credits must be elected from the following group of courses: Engl. 330, 354, 363, 364; Hist. 205, 206, 207, 324; Phil. 260, 350; I. Ad. 365.
Other suggested electives Agron. 424; An. S. 114; B & B. 301, 311; Bot. 216, 402, 404; Chem. 211; Educ. 468; Gen. 305; Hist. 440, 441, 442; Hort. 214; Math. 110, 111, 112, 213; Phys. 113; Psych. 101; T. JI. 225; Zool. 311, 324, 402, 572, 576, 577.

Students electing ROTC may apply ROTC credits toward elective requirement.

Any student may, and especially those preparing for graduate study should, replace Chem. 231 with Chem. 334 and 335.

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**Curriculum in Farm Operation**

Administered by the College of Agriculture.

The curriculum in farm operation is intended for those students who are looking forward to general farming as their life work. It is, therefore, designed to develop those understandings, abilities, and attitudes which are essential to (a) efficient farm operation and management, (b) effective participation as a citizen and leader in a rural community, and (c) personal satisfaction and happiness in rural living.

The farm operation curriculum includes a collegiate winter-quarter program, a two-year program leading to a certificate and a four-year program leading to the degree Bachelor of Science in Farm Operation.

**Winter Quarter Program**

A winter quarter collegiate program is available to the student who plans to spend only one quarter in the University. All courses required in this program will apply toward a Bachelor of Science degree in the event that the student decides to remain in or return to the University. The student who continues may follow the regular farm operation curriculum, described in this section, or transfer to another curriculum.

<table>
<thead>
<tr>
<th></th>
<th>Credits</th>
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<tbody>
<tr>
<td>Ag. 110</td>
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<td>A.E. 134</td>
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<tr>
<td>A.E. 154</td>
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<tr>
<td>Agron. 114B</td>
<td>3</td>
</tr>
<tr>
<td>Agron. 154B</td>
<td></td>
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<tr>
<td>An. S. 114</td>
<td>5</td>
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<tr>
<td>Econ 130</td>
<td>4</td>
</tr>
<tr>
<td>Technical Lecture</td>
<td>R</td>
</tr>
<tr>
<td>Farm Machinery Management</td>
<td>2</td>
</tr>
<tr>
<td>Agricultural Maintenance Welding</td>
<td>2</td>
</tr>
<tr>
<td>Principles of Crop Production</td>
<td>3</td>
</tr>
<tr>
<td>Fundamentals of Soil Science</td>
<td>3</td>
</tr>
<tr>
<td>Elements of Livestock Production</td>
<td>5</td>
</tr>
<tr>
<td>Elements of Farm Management</td>
<td>4</td>
</tr>
</tbody>
</table>
### Two-Year Program

Students who satisfactorily complete at least 96 credits in a prescribed program, have above a 1.75 grade average and find it impractical to continue will receive a Certificate in Technical Agriculture. The two-year program will include those courses specified below:

<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><strong>First Year</strong></td>
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<tr>
<td>Animal Production An S 114</td>
<td>5</td>
<td>Principles of Crop Science Agron 114A</td>
<td>4</td>
<td>Feeds and Feeding</td>
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<tr>
<td>Language in Composition and Reading Engl 104</td>
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<td>Language in Composition and Reading Engl 105</td>
<td>4</td>
<td>Biological Engineering Elective</td>
<td>3</td>
</tr>
<tr>
<td>Elements of Farm Management Econ 130</td>
<td>4</td>
<td>Physical Education</td>
<td>1</td>
<td>Biology of Organisms Biol. 101</td>
<td>3</td>
</tr>
<tr>
<td>Library Instruction Lib 206</td>
<td>1</td>
<td></td>
<td></td>
<td>Physical Education</td>
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<tr>
<td>Farm Operation Orientation Ag 110</td>
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</tbody>
</table>

| **Second Year** |         |                |         |                |         |
| Farm Accounting and Business Analysis Econ 329 | 3 | Principles of Economics Econ 242 | 3 | Fundamentals of Soil Science Agron 154A | 4 |
| Principles of Economics Econ 241 | 3 | Grain and Forage Crops Agron 212 | 4 | Rural Institutions and Organizations Soc. 200 | 4 |

In addition to the courses listed above, the student will be required to include the following:

2. A minimum of 14 credits of free electives

### The Four-Year Major in Farm Operation

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

In addition to the farm operation major, a student may declare one or two minors. This declaration must be made prior to the completion of 140 credits. Students declaring one minor are to include 20 credits in the minor. Students declaring two minors are to include at least 15 credits in each minor. Specific courses in each minor are determined by the farm operation curriculum staff in cooperation with the appropriate department.

<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>Freshman Year</strong></td>
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<td>Elements of Livestock Production An S 114</td>
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<td>Principles of Crop Science Agron 114A</td>
<td>4</td>
<td>Environmental Biology Biol. 103</td>
<td>3</td>
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<tr>
<td>Language in Composition and Reading Engl 104</td>
<td>4</td>
<td>Language in Composition and Reading Engl. 105</td>
<td>4</td>
<td>Biology of Organisms Biol. 102B</td>
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<tr>
<td>Mathematics Lib 206</td>
<td>1</td>
<td>Principles of Biology Biol. 101</td>
<td>3</td>
<td>Rural Institutions and Organizations Soc. 200</td>
<td>4</td>
</tr>
<tr>
<td>Library Instruction</td>
<td>1</td>
<td>Biology of Organisms Biol. 102A</td>
<td>2</td>
<td>Agricultural Engineering Elective</td>
<td>3</td>
</tr>
<tr>
<td>Physical Education</td>
<td>1</td>
<td>Physical Education</td>
<td>1</td>
<td>Physical Education</td>
<td>1</td>
</tr>
<tr>
<td>FALL QUARTER</td>
<td>WINTER QUARTER</td>
<td>SPRING QUARTER</td>
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</tr>
<tr>
<td><strong>Credits</strong></td>
<td><strong>Credits</strong></td>
<td><strong>Credits</strong></td>
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<tr>
<td><strong>Sophomore Year</strong></td>
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</tr>
<tr>
<td>Principles of Economics</td>
<td>Econ 241</td>
<td>3</td>
<td>Principles of Economics</td>
<td>Econ 242</td>
<td>3</td>
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<tr>
<td>General Chemistry</td>
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<td>General Chemistry</td>
<td>Chem 102</td>
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<tr>
<td>Agricultural Engineering Elective</td>
<td>3</td>
<td></td>
<td>Farm Accounting and Business Analysis</td>
<td>Econ 329 (3 cr)</td>
<td>3-4</td>
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<tr>
<td><strong>Junior Year</strong></td>
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<tr>
<td>Principles of Statistics</td>
<td>Stat 201A</td>
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<td>Soil Fertility</td>
<td>Agron. 354</td>
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<td>Introductory Genetics</td>
<td>Gen 301</td>
<td>3</td>
<td>Physical Science Elective</td>
<td>3-4</td>
<td>Principles of Animal Breeding</td>
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<td></td>
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<td>or</td>
<td>Principles of Plant Breeding</td>
<td>Agron 424 (3 cr)</td>
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<td><strong>Senior Year</strong></td>
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<tr>
<td>Soil and Crop Management</td>
<td>Agron 444</td>
<td>4</td>
<td>Appraisal of Farm Real Estate</td>
<td>Econ 440 (3 cr)</td>
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<tr>
<td>Advanced Farm Organization and Management</td>
<td>Econ 430</td>
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<td>or</td>
<td>Agricultural Law</td>
<td>Econ. 451 (3 cr)</td>
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<td>or</td>
<td>Agricultural Finance</td>
<td>Econ 435 (3 cr)</td>
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<td></td>
<td>or</td>
<td>English or Speech Elective</td>
<td>2-3</td>
</tr>
</tbody>
</table>

Students electing ROTC may apply these credits toward elective requirements.

In addition to the courses listed, the student will be required to include the following:

1. Six credits elected from art, history, literature, music, philosophy
4. Ag 104
5. A minimum of 44 credits of free electives

Course selected should be consistent with preparation
2-3 credits elected from Engl 304, 404, 414, Sp 302, 312, 334, 336

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**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 three credits of physical education.
### FALL QUARTER

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Principles of Biology</td>
<td>3</td>
</tr>
<tr>
<td>Biol 101</td>
<td></td>
</tr>
<tr>
<td>Laboratory in Principles of Biology</td>
<td>2</td>
</tr>
<tr>
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<td>Fisheries Management</td>
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<tr>
<td>Zool 465</td>
<td></td>
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</tbody>
</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, philosophy.


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

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

### WINTER QUARTER

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>Environmental Biology</td>
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<tr>
<td>Biol 103</td>
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<tr>
<td>Engl 105</td>
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<tr>
<td>Precalculus Mathematics</td>
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<tr>
<td>Math 103 (5 cr)</td>
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<tr>
<td>or Finite Mathematics</td>
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<td>Math 104 (5 cr)</td>
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### SPRING QUARTER

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<td>Principles of Economics</td>
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<td>Comparative Anatomy</td>
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<td>Zool 224</td>
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<td>Conservation</td>
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<td>Zool 241</td>
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<td>General Plant Ecology</td>
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<td>Fundamentals of Limnology</td>
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</table>
## Curriculum in Food Technology

With options in science and business and opportunities for specialization in various product areas.

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

### Core Requirements

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<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>Stat. 201</td>
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### Science Option

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<td>Biochemistry&lt;sup&gt;2&lt;/sup&gt;</td>
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<td>Phys 113</td>
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<td>Principles of Biology</td>
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<td>Biol 101</td>
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<td>Environmental Biology</td>
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<td>Writing of Reports and Technical Papers</td>
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<td>Engl 414A</td>
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### Business Option

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<td>Principles of Economics</td>
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<td>Econ 243</td>
<td>3</td>
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<td>Money and Banking</td>
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<td>Econ 314</td>
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<td>Labor Economics and Labor Relations</td>
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<td>Industrial Marketing I</td>
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<td>Business Law</td>
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<td>I Ad 365C</td>
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<td>Business Organization and Public Regulation</td>
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<td>I Ad 368</td>
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<td>Industrial Accounting</td>
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<td>I Ad 371</td>
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<td>Introduction to Sociology</td>
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<td>Soc 134</td>
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<tr>
<td>Business and Professional Speaking</td>
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<td>Sp 312A</td>
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<td>T JI 225</td>
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<tr>
<td>Specialization&lt;sup&gt;4&lt;/sup&gt;</td>
<td>18</td>
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</tbody>
</table>

<sup>1</sup>The science option conforms to the standards suggested by the Institute of Food Technologists. The business option does not. Students receiving I F T scholarships must take the science option.

<sup>2</sup>The student may substitute B & B 404 and 405 or D F I 347 and 348. The latter two should be taken by students specializing in dairy technology.

<sup>3</sup>Electives must include six credits of humanities and enough social science to make 12 credits. Humanities include courses in history, literature, music and art appreciation, philosophy. Social science includes courses in economics, psychology, sociology and political science. Students electing ROTC may apply these credits toward elective requirements.

<sup>4</sup>Students should use these 18 credits to specialize in an area or areas of food technology. Recommended courses are:

- Meat technology: An. S 170, 271, 370, 470, 572
- Poultry technology: Po. S 401
- Horticulture: Hort 164
- Nutrition: An. S 318, F & N 107, 305

Other courses may be used to satisfy this requirement on approval of the adviser and department head.

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### Curriculum in Forestry

With options in forest management and forest products. Leading to the degree Bachelor of Science. Total credits required, 204, including three credits of physical education.
FALL QUARTER | Credits | WINTER QUARTER | Credits | SPRING QUARTER | Credits
---|---|---|---|---|---
**Freshman Year**
Introduction to Forestry For 101 | 4 | Precalculus Mathematics Math 103 | 5 | Analytic Geometry and Calculus I Math 110 | 5
Principles of Biology Biol 101 | 3 | Language in Composition and Reading Engl 104 | 4 | Language in Composition and Reading Engl 105 | 4
Principles of Biology Laboratory Biol 101A | 2 | General Chemistry Chem 102A | 4 | General Botany Bot 107 | 5
General Chemistry Chem 101A | 4 | Physical Education | 1 | Physical Education | 1
Library Instruction Lib. 206 | 1 | | | | |
Physical Education | 1 | | | | |

See Index, Mathematics, for description of beginning courses Course selected should be consistent with preparation

**Summer Camp (Required)**
The summer camp is conducted for eight weeks during the summer between the freshman and sophomore years, and is prerequisite to admission to the junior year. The following courses are offered at the freshman summer camp:
Forest Biology, For 201, Cr 3, Wood Utilization, For 202, Cr 3, Forest Mensuration and Mapping, For 203, Cr 4, Forest Operations, For 204, Cr 2

**Sophomore Year**

Principles of Economics Econ 241 | 3 | Principles of Economics Econ 242 | 3 | Fundamentals of Speech Sp 211 | 3
Wood Technology I For 380 | 4 | Wood Technology II For 381 | 3 | Forest Mensuration For 241 | 4
Dendrology Bot 256 | 4 | American Government Pol S 215 | 3 | Introductory Genetics Gen 301 | 3

Elementary Plant Physiology Bot 310 | 4

In addition to the courses specified, each student is required to include the following:
For 110, plus the specified number of credits in courses from the following groups:

I Twenty credits in the following:
Math. 111, 112, 213, 304, 305,
Phys 111, 112, 113, 221, 222, 223,
Chem 103, 211, 231, 334, 335,
Geol. 100,
Zool 376
One course in physics and one in organic chemistry must be included

II Six additional credits in social sciences (economics, government, psychology, sociology).

III Nine credits in humanities (art, history, literature, music, philosophy)

It is recommended that 17 credits from the foregoing groups (exclusive of physical education) be included in the freshman and sophomore years

**Forest Management Option**

**Junior Year**

Forest Economics For 470 | 5 | Forest Biology I For 301 | 4 | Forest Photogrammetry For 445 | 4
Surveying C E 210 | 5 | Forest Soils | | | |

Agron 357 | 5

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<table>
<thead>
<tr>
<th>FALL QUARTER</th>
<th>WINTER QUARTER</th>
<th>SPRING QUARTER</th>
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<tbody>
<tr>
<td><strong>Credits</strong></td>
<td><strong>Credits</strong></td>
<td><strong>Credits</strong></td>
</tr>
<tr>
<td><strong>Senior Year</strong></td>
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<tr>
<td>Writing of Reports and Technical Papers</td>
<td>Forest Management</td>
<td>Political Economy of Forestry</td>
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<tr>
<td>Engl. 414</td>
<td>For 497</td>
<td>For 476</td>
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<td>3</td>
<td>Dynamics of Forest Stands</td>
<td>Forest Pathology</td>
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<td>For 442</td>
<td>Bot 416</td>
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</tbody>
</table>

In addition to the courses specified, each student is required to include six credits in courses dealing with non-forest resources, a minor of 20 credits, 10 credits of electives and practical work (Ag. 104).

**Forest Products Option**

<table>
<thead>
<tr>
<th>Junior Year</th>
<th>Senior Year</th>
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</thead>
<tbody>
<tr>
<td><strong>Credits</strong></td>
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<tr>
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<td>Forest Biology I</td>
<td>For. 301</td>
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<td>Wood-Liquid Relations and Specific Gravity</td>
<td>Physical Properties of Wood For. 488</td>
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<tr>
<td>For. 389</td>
<td>Wood Deterioration Bot 417</td>
</tr>
<tr>
<td>3</td>
<td>4</td>
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</tbody>
</table>

In addition to the courses specified each student is required to include a minor of 25 credits, 10 credits of electives and practical work (Ag. 104).

**Minors**

Each student is required to select one minor consistent with his option and his long range professional objectives and interests. Minors in the forest management option consist of 20 credits. Those in the forest products option include 25 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**
- Biological sciences
- Managerial sciences
- Resource education
- Wildlife biology
- Forest recreation
- Forest range management
- Timber products
- Multiple purpose forestry
- Forestry business
- Urban forestry

**Forest Products minors—25 credits**
- Wood science and technology
- Timber products conversion
- Timber products business

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

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

The student who decides to terminate his study after completion of 96 credits has above a 1.75 grade average and meets requirements similar to the first two years of a four-year program, may be awarded a two-year certificate in agriculture.

<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>
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<td>Freshman Year</td>
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<tr>
<td>Principles of Horticulture Hort. 114A</td>
<td>3</td>
<td>Greenhouse Methods Hort. 154</td>
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<td>Vegetable Crops</td>
<td>Hort. 164</td>
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<td>Horticulture Laboratory Hort. 114B</td>
<td>1</td>
<td>General Botany Bot. 107</td>
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<td>Principles of Biology Biol. 101</td>
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<td>Principles of Biology Laboratory Biol. 101A</td>
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<td>General Psychology I Psych 101</td>
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<td>Sophomore Year</td>
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<tr>
<td>Agricultural Meteorology Agron. 206</td>
<td>3</td>
<td>Plant Propagation Hort. 214</td>
<td>3</td>
<td>Small Fruits Hort. 224</td>
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<td>Principles of Economics Econ 241</td>
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<td>Elementary Organic Chemistry Chem 231</td>
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<td>Finite Mathematics Math 104</td>
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<td>General Zoology Zool 106</td>
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<td>Fundamentals of Speech Sp 211</td>
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### Junior Year

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>Herbaceous Ornamental Plants, Hort. 344</td>
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<tr>
<td>Orcharding, Hort. 321</td>
<td>3</td>
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<tr>
<td>Systematic Horticulture I, Hort. 490</td>
<td>3</td>
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<tr>
<td>Turfgrass Science I, Hort. 314</td>
<td>3</td>
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<tr>
<td>Applied Entomology, Zool. 376</td>
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<tr>
<td>Herbaceous Ornamental Plants, Hort. 345</td>
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<tr>
<td>Systematic Horticulture II, Hort. 491</td>
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<tr>
<td>Plant Physiology, Bot. 310</td>
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<tr>
<td>Introductory Genetics, Gen. 301</td>
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<td>General Bacteriology, Bact. 300</td>
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### Senior Year

<table>
<thead>
<tr>
<th>Course</th>
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<tbody>
<tr>
<td>Seminar, Hort. 401</td>
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<tr>
<td>Systematic Horticulture III, Hort. 492</td>
<td>3</td>
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<tr>
<td>Humanities†</td>
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<tr>
<td>Seminar, Hort. 402</td>
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<tr>
<td>Systematic Horticulture IV, Hort. 493</td>
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<tr>
<td>Marketing Horticultural Crops, Bot. 414</td>
<td></td>
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<tr>
<td>Principles of Plant Pathology, Bot. 407</td>
<td></td>
</tr>
</tbody>
</table>

†The humanities include art, history, literature, philosophy and music.

In addition to the general curriculum requirements, the student will include elective courses to meet the minimum number of credits for graduation.

### Specialized Training

The curriculum in horticulture provides opportunities for general or specialized training and preparation for graduate study through a free choice of electives. Students may modify the basic horticulture curriculum to conform with options selected. A faculty adviser will assist in selecting electives and in arranging schedules.

#### Arboriculture

Omit from basic curriculum: Hort. 164, 224, 344, 345, 492, 493; Bot. 407.

Add to basic curriculum: For. 301; Bot. 356, 404, 416; T. Jl. 225; L. Ad. 384; Hort. 305, 413, 467.


#### Floriculture

Add to basic curriculum. Hort. 247B, 305, 413, 446, 447, 467; Geol. 100


#### Fruit or Vegetable Crops

Add to basic curriculum: Hort. 422, 467; Agron. 114A.

Electives (31 credits): Hort. 514, Psych. 250; Bot. 216, 404, 438; Geol. 100; L. Ad. 365C, Econ. 335; T. Jl. 225, 226, 325.

### Nursery Management

Omit from basic curriculum: Hort. 224, 492, 493.

Add to basic curriculum: Agron. 453; A.E. 306; Bot. 424; Geol. 100; L.A. 210; Hort. 413, 446, 467.


Students wishing to enroll in a four and one-half year program in nursery management during which they would work five quarters (two spring, two summer, one winter) should consult the head of the Department of Horticulture.
Science (for those preparing for graduate study)
Omit from basic curriculum: Chem. 231; Psych. 101; Phys. 101.
Add to basic curriculum: Chem. 103, 334; Hort. 467, 514; Phys. 111, 112.
Electives (31 credits): Chem. 211, 335; Gen. 401; Geol. 100; F. L. 131, 132, 133; Math. 110, 111, 112; Phys. 113; Bot. 404; B. & B. 201.

Turfgrass Management
Omit from basic curriculum: Hort. 164, 224, 321, 414, 492, 493.
Add to basic curriculum: Agron. 114A, 315, 424, 444, 453, 473, 485; A. E. 306; Bot. 216, 424; Geol. 100; Hist. 324; Hort. 305, 413; Soc. 134.
The student will also take Hort. 110 and Ag. 104 (to be completed before the senior year). Students electing ROTC may apply these credits toward elective requirement.

Curricula in Landscape Architecture and Urban Planning

Administered by the Department of Landscape Architecture.
Curricula in landscape architecture and urban planning, leading to the degree Bachelor of Science. Total credits required, 192, including three credits of physical education.

### Landscape Architecture

#### FALL QUARTER

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
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<tbody>
<tr>
<td>Principles of Biology</td>
<td>3</td>
</tr>
<tr>
<td>Biology 101</td>
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</tr>
<tr>
<td>Biology of Organisms</td>
<td>2</td>
</tr>
<tr>
<td>Biology 102A</td>
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</tr>
<tr>
<td>Language in Composition and Reading</td>
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<tr>
<td>Reading 104</td>
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<td>Orientation in Landscape Architecture L.A. 110</td>
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#### WINTER QUARTER

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<tr>
<td>Freshman Year</td>
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<td>Art or Graphics Elective</td>
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<td>Biology of Organisms</td>
<td>2</td>
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<tr>
<td>Biology 102B</td>
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</tr>
<tr>
<td>Environmental Biology</td>
<td>3</td>
</tr>
<tr>
<td>General Chemistry</td>
<td>4</td>
</tr>
<tr>
<td>Introduction to Sociology</td>
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<td>Physical Education</td>
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#### SPRING QUARTER

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<tr>
<td>Fundamentals of Soil Science</td>
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</tr>
<tr>
<td>Agron. 154A</td>
<td></td>
</tr>
<tr>
<td>Language in Composition and Reading</td>
<td>4</td>
</tr>
<tr>
<td>Engl. 105</td>
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<tr>
<td>Introduction to Geology</td>
<td>3</td>
</tr>
<tr>
<td>Geol. 100</td>
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<tr>
<td>Landscape Perception</td>
<td>3</td>
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<tr>
<td>L.A. 113</td>
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<td>Physical Education</td>
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#### Sophomore Year

<table>
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<tr>
<td>Design I</td>
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<tr>
<td>Arch. 315</td>
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</tr>
<tr>
<td>Elementary Surveying</td>
<td>3</td>
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<tr>
<td>C.E. 211A</td>
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<tr>
<td>History of Landscape Architecture L.A. 201</td>
<td>3</td>
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<tr>
<td>Plant Materials</td>
<td>2</td>
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<tr>
<td>L.A. 231</td>
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<tr>
<td>Publicity and Public Relations T. J. 225</td>
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<td>Elective</td>
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<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
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<tbody>
<tr>
<td>Design I</td>
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<tr>
<td>Arch. 315</td>
<td></td>
</tr>
<tr>
<td>Theory of Landscape Design</td>
<td>4</td>
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<tr>
<td>L.A. 213</td>
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<tr>
<td>Plant Materials</td>
<td>2</td>
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<td>L.A. 233</td>
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<td>Details of Construction L.A. 251</td>
<td>3</td>
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<tr>
<td>Survey of Urban Physical Planning Ur. Pl. 253</td>
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<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
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<tbody>
<tr>
<td>Design I</td>
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<td>Arch. 316</td>
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<td>Plant Materials</td>
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<tr>
<td>L.A. 233</td>
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<tr>
<td>Survey of Urban Physical Planning Ur. Pl. 253</td>
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<tr>
<td><strong>FALL QUARTER</strong></td>
<td><strong>Credits</strong></td>
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<td><strong>Junior Year</strong></td>
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<tr>
<td>Collaborative Transportation Development</td>
<td>C.E. 350</td>
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<td>Landscape Design</td>
<td>L.A. 311</td>
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<tr>
<td>Travel and Practice</td>
<td>L.A. 341 or 342 R</td>
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<tr>
<td>Urban Problems and Planning Goals</td>
<td>Ur Pl. 361</td>
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<td>Minor</td>
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<td>Landscape Service</td>
<td>Hort. 305</td>
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<td>Outdoor Recreation in the United States</td>
<td>L.A. 404</td>
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<tr>
<td>Advanced Landscape Design</td>
<td>L.A. 411</td>
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<tr>
<td>Details of Construction III</td>
<td>L.A. 453</td>
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<tr>
<td>Minor</td>
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A minimum of 12 credits must be elected in physical science.

A minimum of six credits must be elected in economics, political science, psychology, or sociology.


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

Students electing ROTC may apply these credits toward elective requirements.

### Urban Planning

<table>
<thead>
<tr>
<th><strong>FALL QUARTER</strong></th>
<th><strong>Credits</strong></th>
<th><strong>WINTER QUARTER</strong></th>
<th><strong>Credits</strong></th>
<th><strong>SPRING QUARTER</strong></th>
<th><strong>Credits</strong></th>
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<tr>
<td><strong>Freshman Year</strong></td>
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<tr>
<td>Principles of Biology</td>
<td>Biol. 101</td>
<td>Biology of Organisms</td>
<td>Biol. 102B</td>
<td>Language in Composition and Reading</td>
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<td>Biology of Organisms</td>
<td>Biol. 102A</td>
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<td>Engl. 105</td>
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<td>Introduction to Geology</td>
<td>Geol. 100</td>
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<td>Algebra and Trigonometry I</td>
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<td>Precalculus Mathematics</td>
<td>Math. 103</td>
<td>Mathematical Geometry</td>
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<td>Math. 103</td>
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<td>Graphic Communication</td>
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<td>Foundations and Frontiers of Physics</td>
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<td>Soc. 134</td>
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<td>Physical Education</td>
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<td>FALL QUARTER</td>
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<td>WINTER QUARTER</td>
<td>Credits</td>
<td>SPRING QUARTER</td>
<td>Credits</td>
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<td><strong>Sophomore Year</strong></td>
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<td>Design I</td>
<td>3</td>
<td>American Government</td>
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<td>Theory of Landscape Design</td>
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<tr>
<td>Elementary Surveying</td>
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<td>Principles of Economics</td>
<td>3</td>
<td>L.A. 213</td>
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<td>C.E. 211A</td>
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<td>Econ 242</td>
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<td>Principles of Statistics</td>
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<td>Econ. 241</td>
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<td>Stat. 201</td>
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<td>Survey of Urban Physical Planning</td>
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<td>Fundamentals of Speech</td>
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<td>Humanities Elective</td>
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<td>Ur. Pl 253</td>
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<td>Sp. 211</td>
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<td>Humanities Elective</td>
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| **Junior Year** | | | | | |
| Collaborative Transportation Development | C.E. 350 | 3 | Physical Science Elective | Traffic Planning | 4 |
| C.E. 350 | 3 | Planning Analysis and | C.E. 451 | 4 |
| Introduction to Computer | | | | | |
| Organization and Programming | | | | | |
| Com. S. 214 | 3 | Techniques | Urban Regional Economics | 3 |
| Landscape Design | | | | | |
| L.A. 311 | 3 | | Econ. 461 | 3 |
| Travel and Practice | | | | | |
| Ur. Pl. 341 or 342 | R | Group Elective | Planning Analysis and | 4 |
| Urban Problems and Planning Goals | | | Techniques | 3 |
| Ur. Pl. 361 | 3 | Minor | | 3 |
| Minor | 3 | | | | |

| **Senior Year** | | | | | |
| Urban-Regional Economics | | | Collaborative Studio in Regional Physical Planning | 3 |
| Econ. 462 | 3 | Engineering in City Planning | Ur. Pl. 433 | 3 |
| Travel and Practice | | | Group Electives | 8 |
| Ur. Pl. 341 or 342 | R | Theory of the Planning Process | Minor | 4 |
| Urban Development Planning | | | | | |
| Ur. Pl. 431 | 4 | Urban Development Programming | | | |
| Planning Law and Administration | | | | | |
| Ur. Pl. 492 | 4 | Group Elective | | | |
| Group Elective | 3 | Minor | | | |
| Minor | 3 | | | | |

Group Electives a minimum of one course each from groups I and II below and two courses each from groups III and IV below.

I. Housing Arch 363, F E 340, 521
II. Politics and Political Theory Pol S 230, 241, 433, 464, 466
III. Area Government, Administration and Finance Pol S 310, 311, 471, 476, Econ 405
IV. Sociology and Geography of Urban Areas Soci. 135, 410, 450, 495, Geog 421

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

Students electing ROTC may apply ROTC credits toward the elective requirements.

For his humanities electives, the student should choose a sequence from one of the following three fields: philosophy, history, or literature.
Curriculum in Plant Pathology

Major in Plant Pathology

Administered by the Department of Botany and Plant Pathology.

Leading to the degree Bachelor of Science. Total credits required, 192, including three 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.

College and Departmental Group Requirements

<table>
<thead>
<tr>
<th>College and Departmental Group Requirements</th>
<th>Credits</th>
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<tbody>
<tr>
<td>I. Written and Spoken English</td>
<td>14</td>
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<tr>
<td>(including Engl. 104, 105; Sp. 211)</td>
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<tr>
<td>II. Mathematics; Statistics</td>
<td>12</td>
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<tr>
<td>(including Math. 101 or equivalent)</td>
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<tr>
<td>III. Physical Sciences</td>
<td>16</td>
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<tr>
<td>(including Chem. 101, 102; Phys. 111 or 221)</td>
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<tr>
<td>IV. Biological Sciences</td>
<td>18</td>
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<tr>
<td>(including Biol. 101, 101A, 103; Bot 107; Zool. 106)</td>
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<tr>
<td>V. Agricultural Sciences</td>
<td>10</td>
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<tr>
<td>(including Agron. 154A, 206)</td>
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<tr>
<td>VI. Social Sciences</td>
<td>15</td>
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<tr>
<td>(including Econ. 241, 242, Pol S 215)</td>
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<tr>
<td>VII. Humanities</td>
<td>15</td>
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<tr>
<td>(including credits in history and literature)</td>
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Departmental Major and Minor Requirements

I. Plant Pathology major, minimum 30 credits
   (including Bact. 304, Bot. 306, 320, 404, 407 or 416, Gen 301, Zool. 274.)

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.

Students electing ROTC may apply ROTC credits toward elective requirements.

Curriculum in Poultry Science

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

In addition to the poultry science major, a student may declare one or two minors. The declaration must be made prior to completion of 140 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, including additional courses in biochemistry, biophysics, chemistry, computer science, mathematics, physics, statistics.
Business, including additional courses in economics, industrial administration, psychology, speech.

Communications, including additional courses in English, speech, technical journalism, telecommunicative arts.

Education, including additional courses in education, psychology, sociology.

Extension service training, including additional courses in agricultural education, psychology, sociology.

International service, including additional courses in anthropology, economics, foreign languages, political science, sociology.

Plant sciences, including additional courses in agronomy, botany, forestry, horticulture, plant pathology.

Students may also elect a departmental minor or minors in departments administered through the College of Agriculture.

For the poultry science major all students have the following core requirements:

<table>
<thead>
<tr>
<th>FALL QUARTER</th>
<th>Credits</th>
<th>WINTER QUARTER</th>
<th>Credits</th>
<th>SPRING QUARTER</th>
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<tbody>
<tr>
<td>Animal Production</td>
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<td>Principles of Biology Laboratory</td>
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<td>Chem. 102</td>
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<tr>
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<td>V. An. 217 (3 cr.)</td>
<td>2</td>
<td>Poultry Seminar</td>
<td>Po. S. 305</td>
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<tr>
<td>or</td>
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<tr>
<td>Comparative Anatomy</td>
<td>Zool. 224 (4 cr.)</td>
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<td>Physiology of Domestic Animals</td>
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### College of Agriculture

#### FALL QUARTER

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<td>Po. S. 401</td>
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<td>Poultry Nutrition</td>
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#### SPRING QUARTER

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<td>Po. S. 402</td>
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</table>

In addition to the courses listed in the core, each student is required to take at least three credits of social sciences. Students electing ROTC may apply these credits toward elective requirements.

1Chem. 103 is prerequisite.
2Humanities include art, foreign languages, history, literature, music or philosophy.

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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 three credits of physical education.

#### FALL QUARTER

<table>
<thead>
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#### WINTER QUARTER

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<td>Biology of Organisms</td>
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<td>Biol. 102B</td>
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#### SPRING QUARTER

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<td>An. S. 114</td>
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<tr>
<td>Principles of Crop Science</td>
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### Sophomore Year

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<td>Fundamentals of Speech</td>
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<td>Sp. 211</td>
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<td>Principles of Economics</td>
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<td>Econ. 242</td>
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<tr>
<td>Computer Science</td>
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<td>Com. S. 214</td>
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<table>
<thead>
<tr>
<th>Course</th>
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<tbody>
<tr>
<td>Publicity and Public Relations</td>
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<tr>
<td>T. JI. 225</td>
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<tr>
<td>Fundamentals of American Government</td>
<td>3</td>
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<tr>
<td>Pol S 305</td>
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<tr>
<td>Fundamentals of Soil Science</td>
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<td>Humanities Elective</td>
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### Curriculum in Resource Development for Outdoor Recreation

Administered by the College in Agriculture through the Office of the Associate Dean. Leading to the degree Bachelor of Science. Total credits required, 192, including three credits of physical education.

The curriculum is designed for those who wish to manage natural resources to be utilized for outdoor recreation. The resources might include areas of land under private ownership developed for recreation, or publicly owned parks, forests, rivers, lakes, or coastal areas. The curriculum has a broad base of general education subjects with more than half the credits in communications, mathematics, physical and biological sciences, and the social sciences and humanities. The technical subjects represent a combination of agronomy, horticulture, forestry, fish and wildlife biology, and landscape architecture with emphasis on beautification, utilization and conservation of water, soil, and plant resources for their optimal value in meeting the needs of society.

<table>
<thead>
<tr>
<th>FALL QUARTER</th>
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<th>SPRING QUARTER</th>
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<td>General Botany</td>
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<td>Psych. 101</td>
<td>L A 113</td>
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<td>Laboratory in Principles of Biology</td>
<td>Recreational Use of Forest Resources</td>
<td>Introduction to Sociology</td>
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<tr>
<td>Physical Education</td>
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</tbody>
</table>

*Ag 104 (six months of work experience) is required before graduation. Students electing ROTC may apply these credits toward elective requirements.*
<table>
<thead>
<tr>
<th>FALL QUARTER</th>
<th>Credits</th>
<th>WINTER QUARTER</th>
<th>Credits</th>
<th>SPRING QUARTER</th>
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<tr>
<td>Principles of Economics Econ. 241</td>
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<td>Survey of Landscape Architecture L.A. 210</td>
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<td>Introduction to Geology Geol. 100</td>
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<td>Turfgrass Science I Hort. 314</td>
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<td>Ornithology Zool. 340A</td>
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<td>Introductory Bacteriology I Bact. 200</td>
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<td>Publicity and Public Relations T Jl 225</td>
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<tr>
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<td>Principles of Wildlife Conservation Zool 241</td>
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<td>Agricultural Law Econ. 451</td>
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<td>Ichthyology Zool. 464</td>
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<td>Water Use in Outdoor Recreation A. E. 371</td>
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<td>Group Dynamics Soc. 364</td>
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<td>History of American Agriculture Hist. 375</td>
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Additional requirements. Ag. 110 or the equivalent in the freshman year, three credits in the humanities, 17 credits in elective courses and Ag. 104 (six months of work experience).

Students electing ROTC may apply these credits toward elective requirements.

### 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>
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<tr>
<th>FALL QUARTER</th>
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<th>WINTER QUARTER</th>
<th>Credits</th>
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<td>Sp. 312</td>
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</tbody>
</table>

\(^1\)Soc. 200, 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>FALL QUARTER</th>
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<th>WINTER QUARTER</th>
<th>Credits</th>
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<td>Math. 110</td>
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Training for International Service

Agricultural students desiring to work in foreign countries with private industry, government agencies, or private foundations and institutions are referred to the section headed International Service 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 are offered courses in education for all undergraduate students seeking teaching certificates for the elementary and secondary schools. In addition, certain undergraduate non-teaching 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, including Pol. S. 215, 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 half-time 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.

Special graduate programs are available for those who seek approval as 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 Engi. 104, 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 three 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:

Educ 204, Foundations of American Education 3 Credits
Educ 305B, Methods of Teaching 1 Credit
Psych 230, Developmental Psychology 3 Credits
Psych 333, Educational Psychology 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

Educ 305A - Methods of Teaching 3 Credits
Educ 426 Principles of Secondary Education 3 Credits

PROFESSIONAL COURSES IN AREAS OF SPECIALIZATION

Agricultural Education: Ag. Ed. 211, 321, 423, 424, 425.
Art: A.A. 415, 416, 418, 419.
Biology: D. St. 417D, 486.
Chemistry: D. St. 417B, 486.
Earth Science: D. St. 417J, 486.
English: Engl. 494, D. St. 417E.
Foreign Languages: F. I. 476, D. St. 417G.
General Science: D. St. 417B, 486.
Industrial Education: I. Ed. 415, 416.
Journalism: T. Jl. 480, D. St. 417I.
Mathematics: Math. 497, D. St. 417C.
Music: Music 336, 466, (367-368-369¹), D.St. 417K.
Physical Education for Men: P.E.M. 497, D.St. 417F.
Physical Education for Women: P.E.W. 269, 376, 385, 417, or 417 and 418.
Physics: D.St. 417B, 486.
Safety Education: I.Ed. 270, 370, 371.
Social Studies: D.St. 417A, 496.
Speech: Sp. 495, D.St. 417H.

¹ Practicum 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>Child Development</th>
<th>236</th>
<th>Elementary Education</th>
<th>344</th>
<th>Music</th>
<th>365</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>240</td>
<td></td>
<td>375</td>
<td>Physical Education for Women</td>
<td>470</td>
</tr>
<tr>
<td></td>
<td>336</td>
<td></td>
<td>445</td>
<td>Speech</td>
<td>375</td>
</tr>
<tr>
<td></td>
<td>337</td>
<td></td>
<td>446</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>460</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

NURSERY-KINDERGARTEN

Students seeking approval to teach at the nursery-kindergarten level must complete the child development core and earn the following credits

<table>
<thead>
<tr>
<th>Child Development</th>
<th>467A</th>
<th>Sociology 485 or F E. 385</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>467B</td>
<td>Three credits of electives from English, journalism, or speech</td>
</tr>
<tr>
<td></td>
<td>467E</td>
<td></td>
</tr>
</tbody>
</table>

VOCATIONAL AGRICULTURE

Students seeking approval to teach vocational agriculture must earn credits in the following courses

<table>
<thead>
<tr>
<th>Agricultural Education</th>
<th>254</th>
<th>Agronomy</th>
<th>114A</th>
<th>Animal Science</th>
<th>114</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>255</td>
<td></td>
<td>154A</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>334</td>
<td></td>
<td>315</td>
<td></td>
<td>318</td>
</tr>
<tr>
<td></td>
<td>415</td>
<td></td>
<td>354</td>
<td></td>
<td>319</td>
</tr>
</tbody>
</table>

Economics 241
242
329
330
335

Industrial Education 120
Poultry Science 365
15 credits of electives in technical agriculture
APPLIED ART

Students seeking approval to teach art in secondary schools must earn credits in the following courses

<table>
<thead>
<tr>
<th>Applied Art</th>
<th>100</th>
<th>233</th>
<th>344</th>
<th>404</th>
</tr>
</thead>
<tbody>
<tr>
<td>Applied Art</td>
<td>104</td>
<td>250</td>
<td>345</td>
<td>445</td>
</tr>
<tr>
<td>Applied Art</td>
<td>107</td>
<td>261</td>
<td>384</td>
<td>446</td>
</tr>
<tr>
<td>Applied Art</td>
<td>150</td>
<td>306</td>
<td>393</td>
<td>483</td>
</tr>
<tr>
<td>Applied Art</td>
<td>203</td>
<td>324</td>
<td>401</td>
<td>486</td>
</tr>
<tr>
<td>Applied Art</td>
<td>207</td>
<td>335</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Students seeking approval to teach art, kindergarten through grade twelve, must earn credits in the following courses

<table>
<thead>
<tr>
<th>Applied Art</th>
<th>100</th>
<th>233</th>
<th>345</th>
<th>404</th>
</tr>
</thead>
<tbody>
<tr>
<td>Applied Art</td>
<td>104</td>
<td>250</td>
<td>384</td>
<td>424</td>
</tr>
<tr>
<td>Applied Art</td>
<td>107</td>
<td>261</td>
<td>393</td>
<td>486</td>
</tr>
<tr>
<td>Applied Art</td>
<td>150</td>
<td>306</td>
<td>401</td>
<td>444 or 445 or 446</td>
</tr>
<tr>
<td>Applied Art</td>
<td>203</td>
<td>335</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Students seeking restricted approval to teach art must earn credits in the following courses

<table>
<thead>
<tr>
<th>Applied Art</th>
<th>103</th>
<th>Two courses selected from</th>
</tr>
</thead>
<tbody>
<tr>
<td>Applied Art</td>
<td>150</td>
<td>104, 107, 213, 250, 324, 344, 424,</td>
</tr>
<tr>
<td>Applied Art</td>
<td>233</td>
<td>435, 445, 486</td>
</tr>
<tr>
<td>Applied Art</td>
<td>261</td>
<td></td>
</tr>
<tr>
<td>Applied Art</td>
<td>335</td>
<td></td>
</tr>
<tr>
<td>Applied Art</td>
<td>345</td>
<td></td>
</tr>
<tr>
<td>Applied Art</td>
<td>384</td>
<td></td>
</tr>
</tbody>
</table>

BIOLOGY

Students seeking approval to teach biology must earn credits in the following courses

<table>
<thead>
<tr>
<th>Bacteriology</th>
<th>300 or 304</th>
<th>Botany</th>
<th>107</th>
<th>Genetics</th>
<th>301 or 400</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biochemistry</td>
<td>301 or 401</td>
<td>and 405</td>
<td>203 or 306 or 301</td>
<td>Zoology</td>
<td>106</td>
</tr>
<tr>
<td>Biophysics</td>
<td>301 or 405</td>
<td>Four or more credits from</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Biology</td>
<td>101</td>
<td>310, 320, 404</td>
<td></td>
<td>155 or 355</td>
<td></td>
</tr>
<tr>
<td></td>
<td>101A</td>
<td></td>
<td>224 or 359</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>103</td>
<td></td>
<td>234 or 358</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>274 or 376</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Students seeking restricted approval to teach biology must earn credits in the following courses

<table>
<thead>
<tr>
<th>Bacteriology</th>
<th>300 or B &amp; B 301</th>
<th>Botany</th>
<th>107</th>
<th>Zoology</th>
<th>106</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biology</td>
<td>101</td>
<td>203 or 306</td>
<td></td>
<td>155 or 355</td>
<td></td>
</tr>
<tr>
<td></td>
<td>101A</td>
<td></td>
<td></td>
<td>274 or 376</td>
<td></td>
</tr>
<tr>
<td></td>
<td>103</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

CHEMISTRY

Students seeking approval to teach chemistry must earn credits in the following courses

<table>
<thead>
<tr>
<th>Chemistry</th>
<th>102A or 102</th>
<th>320A and 320B and 321</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>103 or 107 or 108</td>
<td>and 322 and 323, or 224 and 325 and</td>
</tr>
<tr>
<td></td>
<td>203</td>
<td>326 and 327A and 327B</td>
</tr>
<tr>
<td></td>
<td>211 or 214</td>
<td>Physics 221</td>
</tr>
<tr>
<td></td>
<td>334 and 335 and 336, or</td>
<td></td>
</tr>
<tr>
<td></td>
<td>237 and 330 (3 quarters) and 331 and</td>
<td></td>
</tr>
<tr>
<td></td>
<td>332 and 333</td>
<td></td>
</tr>
</tbody>
</table>

Students seeking restricted approval to teach chemistry must earn credits in the following courses

<table>
<thead>
<tr>
<th>Chemistry</th>
<th>102A or 102</th>
<th>321</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>103 or 107 or 108</td>
<td>322</td>
</tr>
<tr>
<td></td>
<td>203</td>
<td>335 (must be taken for</td>
</tr>
<tr>
<td></td>
<td>211</td>
<td>4 credits)</td>
</tr>
<tr>
<td></td>
<td>234</td>
<td></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>
</tr>
</thead>
<tbody>
<tr>
<td>Geology 100</td>
<td>321</td>
</tr>
<tr>
<td>Geology 261</td>
<td>322 or 211</td>
</tr>
<tr>
<td>Geology 171</td>
<td>431</td>
</tr>
<tr>
<td>Geology 202 (field course, 9 credits)</td>
<td></td>
</tr>
<tr>
<td>Meteorology 390X</td>
<td></td>
</tr>
<tr>
<td>Physics 151</td>
<td></td>
</tr>
<tr>
<td>Physics 152</td>
<td></td>
</tr>
<tr>
<td>Physics 153</td>
<td></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>Geology 100</td>
<td></td>
</tr>
<tr>
<td>Geology 171</td>
<td></td>
</tr>
<tr>
<td>Geology 202 (field course, 9 credits)</td>
<td></td>
</tr>
<tr>
<td>Meteorology 390X</td>
<td></td>
</tr>
</tbody>
</table>

**ENGLISH**

Students seeking approval to teach English must earn credits in the following:

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>English 304A or 304B</td>
<td>375A</td>
</tr>
<tr>
<td>English 363A</td>
<td>375A</td>
</tr>
<tr>
<td>English 364A</td>
<td>375A</td>
</tr>
<tr>
<td>English 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:

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>English 304A or 304B</td>
<td></td>
</tr>
<tr>
<td>English 363A</td>
<td></td>
</tr>
<tr>
<td>English 364A</td>
<td></td>
</tr>
</tbody>
</table>

**FOREIGN LANGUAGES**

Students seeking approval to teach foreign languages must earn 45 credits in one language:

- French majors must include 204, 205, 206, 311, 312, 313, 314, 315, and 316
- Spanish, German and Russian majors must include elementary composition and conversation

Only if full approval in one foreign language is obtained will restricted approval in a second language be granted. Under these circumstances restricted approval may be gained if 30 credits are earned, nine of which must be composition and conversation.

**GENERAL SCIENCE**

Students seeking approval to teach general science must earn the following credits:

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biology 101</td>
<td></td>
</tr>
<tr>
<td>Biology 101A</td>
<td></td>
</tr>
<tr>
<td>Biology 103</td>
<td></td>
</tr>
<tr>
<td>Botany 107</td>
<td></td>
</tr>
<tr>
<td>Botany 203 or 301 or 306</td>
<td></td>
</tr>
<tr>
<td>Chemistry 102 and 103, or 107 and 108</td>
<td></td>
</tr>
<tr>
<td>Earth Science Geol 100, 171 or 351 or 381</td>
<td></td>
</tr>
<tr>
<td>Physics 111 and 112 and 113, or 221 and 222 and 223</td>
<td></td>
</tr>
<tr>
<td>Zoology 106</td>
<td></td>
</tr>
<tr>
<td>Zoology 155 or 355</td>
<td></td>
</tr>
<tr>
<td>Zoology 274 or 376</td>
<td></td>
</tr>
</tbody>
</table>

Students seeking restricted approval to teach general science must earn the following credits:

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biology 101</td>
<td></td>
</tr>
<tr>
<td>Biology 102A and 102B, or 106 and 107</td>
<td></td>
</tr>
<tr>
<td>Chemistry 4 or 5 credits from 101, or 105 and 106</td>
<td></td>
</tr>
<tr>
<td>Geology 100</td>
<td></td>
</tr>
<tr>
<td>Physics 4 or 5 credits from 106 or 111 or 221</td>
<td></td>
</tr>
<tr>
<td>Five or more credits from Bot 155 or 301</td>
<td></td>
</tr>
<tr>
<td>Gen 301 or 400</td>
<td></td>
</tr>
<tr>
<td>Zool 155 or 355</td>
<td></td>
</tr>
</tbody>
</table>

Select additional credits from physical or biological sciences to meet the 30 credit minimum.
HISTORY AND GOVERNMENT

Students seeking approval to teach history and government must earn credits in the following courses:

<table>
<thead>
<tr>
<th>History</th>
<th>Political Science</th>
</tr>
</thead>
<tbody>
<tr>
<td>205 206 207</td>
<td>321 322 323</td>
</tr>
</tbody>
</table>

12 credits from other courses

Courses numbered 300 or above

HOME ECONOMICS

Students seeking approval to teach home economics must complete credits in the following courses:

<table>
<thead>
<tr>
<th>Applied Art</th>
<th>Family Environment</th>
<th>Food and Nutrition</th>
</tr>
</thead>
<tbody>
<tr>
<td>103 261</td>
<td>236 337</td>
<td>107 208 303</td>
</tr>
</tbody>
</table>

3 credits chosen from A A 262, Arch 361, F E 240, 318, 445, 446, 521

12 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</th>
<th>Architecture</th>
<th>Agricultural Engineering</th>
</tr>
</thead>
<tbody>
<tr>
<td>105 106 110 121 123</td>
<td>205 220 232 234 236</td>
<td>251 253 260 262 263</td>
</tr>
</tbody>
</table>

JOURNALISM

Students seeking approval to teach journalism must earn 32 credits in technical journalism as follows:

<table>
<thead>
<tr>
<th>Two to four courses chosen from</th>
<th>Two to four courses chosen from</th>
<th>At least three courses chosen from</th>
</tr>
</thead>
<tbody>
<tr>
<td>201 202 325</td>
<td>203 317 319 326</td>
<td>417 430 462 463</td>
</tr>
</tbody>
</table>

15 credits in written and spoken English

T J I 4901, professional work requirement

MATHEMATICS

Students seeking approval to teach mathematics must earn credits in the following courses:

<table>
<thead>
<tr>
<th>Mathematics</th>
<th>12 credits in courses</th>
</tr>
</thead>
<tbody>
<tr>
<td>110</td>
<td>numbered 300 or above</td>
</tr>
<tr>
<td>111 112</td>
<td>6 credits in algebra¹</td>
</tr>
<tr>
<td>490</td>
<td>6 credits in geometry²</td>
</tr>
<tr>
<td></td>
<td>15 additional credits</td>
</tr>
</tbody>
</table>

Students seeking restricted approval to teach mathematics must earn the following credits:

18 credits in Math 110, 111, 112, 490, and 12 additional credits, including one algebra and one geometry course

¹ Math. 190, 191, 301, 302, 303, 404, 450.
² Math. 192, 330, 331, 436, 437.
**MUSIC**

Students seeking approval to teach music (kindergarten through grade 14) 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>366</td>
</tr>
<tr>
<td></td>
<td>444</td>
</tr>
<tr>
<td></td>
<td>240 or 460 or 470</td>
</tr>
</tbody>
</table>

Music:

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
<td>305</td>
</tr>
<tr>
<td>306</td>
<td>367</td>
</tr>
<tr>
<td>319</td>
<td>368</td>
</tr>
<tr>
<td>355</td>
<td>369</td>
</tr>
<tr>
<td>356</td>
<td>490A</td>
</tr>
<tr>
<td>357</td>
<td>419</td>
</tr>
<tr>
<td>361</td>
<td></td>
</tr>
<tr>
<td>364</td>
<td></td>
</tr>
</tbody>
</table>

3 or 4 credits from

4 to 6 credits from advanced music history courses

1 Students seeking approval to teach in only the elementary school or in only the secondary school should confer with the Music Department concerning modifications in this program.

2 Practicum series and minor applied music not required for those planning to teach vocal choral music.

**PHYSICAL EDUCATION FOR MEN**

Students seeking approval to teach physical education for men must earn credits in the following courses:

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>213</td>
<td>391</td>
</tr>
<tr>
<td>220</td>
<td>493</td>
</tr>
<tr>
<td>309</td>
<td></td>
</tr>
</tbody>
</table>

30 credits chosen from

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>212</td>
<td>301</td>
</tr>
<tr>
<td>214</td>
<td>303</td>
</tr>
<tr>
<td>215</td>
<td>314</td>
</tr>
<tr>
<td>216</td>
<td>315</td>
</tr>
<tr>
<td>217</td>
<td>316</td>
</tr>
<tr>
<td>218</td>
<td>317</td>
</tr>
<tr>
<td>219</td>
<td>318</td>
</tr>
</tbody>
</table>

P E W 480

P E W 495

Students seeking restricted approval to teach physical education for men must earn credits in the following courses:

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>309</td>
<td></td>
</tr>
<tr>
<td>391</td>
<td></td>
</tr>
<tr>
<td>493</td>
<td></td>
</tr>
</tbody>
</table>

21 credits from courses selected from those leading to approval to teach physical education for men.

**PHYSICAL EDUCATION FOR WOMEN**

Students seeking approval to teach physical education for women must earn credits in the following courses:

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>118</td>
<td>251</td>
</tr>
<tr>
<td>165</td>
<td>275</td>
</tr>
<tr>
<td>190</td>
<td>370</td>
</tr>
</tbody>
</table>

Physical Education for Women

Hygiene

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>104A</td>
<td></td>
</tr>
<tr>
<td>104B</td>
<td></td>
</tr>
<tr>
<td>304</td>
<td></td>
</tr>
</tbody>
</table>

Additional courses in one of three options

A. PHYSICAL EDUCATION FOR WOMEN

- SECONDARY

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>150</td>
<td>252</td>
</tr>
<tr>
<td>151</td>
<td>270</td>
</tr>
<tr>
<td>152</td>
<td>271</td>
</tr>
<tr>
<td>250</td>
<td>375</td>
</tr>
</tbody>
</table>

A credit of swimming elective

B. DANCE

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical Education for Women</td>
<td></td>
</tr>
<tr>
<td>117</td>
<td>213</td>
</tr>
<tr>
<td>210</td>
<td>310</td>
</tr>
</tbody>
</table>

C. PHYSICAL EDUCATION IN ELEMENTARY SCHOOLS

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>All requirements for Option A</td>
<td></td>
</tr>
<tr>
<td>472</td>
<td></td>
</tr>
<tr>
<td>473</td>
<td></td>
</tr>
</tbody>
</table>

Applied Art 103

Select from P E W 150 and 152 and 377, or 150 and 250 and 375, or swimming electives and 379

Music 365
PHYSICS
Students seeking approval to teach physics must earn credits in the following courses:

- **Chemistry**: 102 (or 102A), 103
- **Physics**: 221, 301, 302, 303, 311, 344, 345, 354, 355, 394

Students seeking restricted approval to teach physics must earn credits in the following courses:

- **Chemistry**: 102 (or 102A), 103
- **Physics**: 221, 301, 302, 303

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:

- **15 credits chosen from**
  - Industrial Education: 216, 570, 316, 571, 317, 590S, 490S
  - Education: 501
  - Education: 536, 537, 552, 553
  - Ed: 261, 305, 351, 361, 361B, 368
  - T: 101
  - C: 352, 450
  - E: 421
  - Econ: 305, 444, 445
  - Ad: 463
  - Psych: 440, 450, 451, 500, 533, 540, 550, 699

SOCIAL STUDIES
Students seeking approval to teach history, economics, government, civics, sociology, geography and senior problems must earn the following credits:

- **Economics**: 9 credits chosen from
  - 241, 306
  - 242, 307
  - 243, 308
  - 304, 409
  - 305, 455

- **Geography**: 9 credits chosen from
  - Geol: 100
  - Geog: 201
  - 261
  - 321

- **History and Government**: 6 credits chosen from
  - Hist: 321
  - Pol: 215
  - 322
  - 323
  - 205
  - 206

- **Sociology and Anthropology**: 9 credits
  - Soc: 134, 305, 321
  - Anthro: 218, 336, 421
  - 300, 364
  - 301, 485

Students seeking restricted approval to teach any three of the following must take nine credits in each of two fields and twelve credits in the third field as outlined above: economics, geology, government, American history, world history, sociology.

SPEECH
Students seeking approval to teach speech must earn credits in the following courses:

- **Speech**: 207, 325, 232A, 375, 302, 405, 309
  - 18 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
Marjorie S. Garfield

Biology
Delma E. Harding

Chemistry
Robert E. McCarley

Earth Science
Keith M. Hussey

English
Duncan Mallam

Foreign Languages
Floyd A. Pace

General Science
George Knaphus

Home Economics Education
Alberta D. Hill

Industrial Education
Lowell L. Carver

Nursery-Kindergarten
Samuel Clark

Journalism
James W. Schwartz

Mathematics
Orlando C. Kreider

Music
Laurence Burkhalter

Physical Education for Men
Harry J. Schmidt

Physical Education for Women
Barbara E. Forker

Physics
Lester T. Earls

Safety Education¹
Lillian C. Schwenk

Social Studies (economics, sociology, government, geography and history)
Alan Wilt

Speech
William R. Underhill

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.

Each student will have a faculty adviser in his chosen curriculum to aid in planning his program. An orientation program is held each summer for entering students and their parents. During this time students have an opportunity to become acquainted with Iowa State and the College of Education, to meet with faculty advisers regarding the program of studies, and to take placement tests.

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.

<table>
<thead>
<tr>
<th>I General Education</th>
<th>75 Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>A Biological Sciences</td>
<td>9 21 Credits</td>
</tr>
<tr>
<td>Biol 101 Principles of Biology</td>
<td>3 Credits</td>
</tr>
<tr>
<td>Zool 155 Human Physiology and Anatomy</td>
<td>5 Credits</td>
</tr>
<tr>
<td>Options biology, botany, nutrition and zoology</td>
<td></td>
</tr>
<tr>
<td>B Communicative Arts</td>
<td>14 21 Credits</td>
</tr>
<tr>
<td>Engl 104, 105 Language in Composition and Reading</td>
<td>8 Credits</td>
</tr>
<tr>
<td>Sp 211 Fundamentals of Speech</td>
<td>3 Credits</td>
</tr>
<tr>
<td>Options English, speech, journalism</td>
<td></td>
</tr>
<tr>
<td>C Humanities</td>
<td>15-21 Credits</td>
</tr>
<tr>
<td>Engl 201 Introduction to Literature</td>
<td>3 Credits</td>
</tr>
<tr>
<td>History Any combination</td>
<td>6 Credits</td>
</tr>
<tr>
<td>Phil 260 Introduction to Philosophy</td>
<td>3 Credits</td>
</tr>
<tr>
<td>Options art, history, literature, music, foreign language, philosophy</td>
<td></td>
</tr>
<tr>
<td>D Physical Sciences and Mathematics</td>
<td>16-21 Credits</td>
</tr>
<tr>
<td>Geol 100 Introduction to Geology</td>
<td>3 Credits</td>
</tr>
<tr>
<td>Geog 201 World Geography</td>
<td>3 Credits</td>
</tr>
<tr>
<td>Math 190 Theory of Arithmetic</td>
<td>3 Credits</td>
</tr>
<tr>
<td>Math 191 or 192, Mathematics Concepts II or III</td>
<td>3 Credits</td>
</tr>
<tr>
<td>Chem 101 General Chemistry (4 cr)</td>
<td>3 Credits</td>
</tr>
<tr>
<td>or Phys. 106. Elementary Physics (4 cr)</td>
<td>4 Credits</td>
</tr>
<tr>
<td>E Social Science</td>
<td>15-21 Credits</td>
</tr>
<tr>
<td>Anthro 218 Introduction to Cultural Anthropology</td>
<td>3 Credits</td>
</tr>
<tr>
<td>Econ 241 Principles of Economics</td>
<td>3 Credits</td>
</tr>
<tr>
<td>Pol S 215 American Government</td>
<td>3 Credits</td>
</tr>
<tr>
<td>Psych 101 Introduction to Psychology</td>
<td>3 Credits</td>
</tr>
<tr>
<td>Soc 134 Introduction to Sociology</td>
<td>3 Credits</td>
</tr>
</tbody>
</table>

II Professional Education Core

Educ 204 Foundations of American Education | 3 Credits |
Educ 305B Methods of Teaching (Audio-Visual Laboratory) | 1 Credit |
Psych 230 Developmental Psychology | 3 Credits |
Psych 333 Educational Psychology | 3 Credits |
III Courses in the Major

A Child Development
- CD 236 Principles of Child Development  3 Credits
- CD 240 Literature for Children  4 Credits
- CD 336 Development in Early Childhood  4 Credits
- CD 337 Development and Guidance in Later Childhood  3 Credits
- CD 460 Guidance of Children  4 Credits

B Education
- El Ed 344 Principles of Teaching in Elementary Schools  2 Credits
- El Ed 374. Teaching of Reading  5 Credits
- El Ed 445 Elementary Education Methods I (language arts and social studies)  4 Credits
- El Ed 446 Elementary Education Methods II (mathematics-science)  4 Credits

C Student Teaching
- Educ 467C Student Teaching in Primary Grades  8 Credits
- Educ 467D Student Teaching in the Intermediate Grades  8 Credits

D Related Methods
- Music 365 Music in the Elementary Schools  3 Credits
- P E W 470 Elementary School Physical Education  3 Credits
- Sp 375 Speech Correction Principles  3 Credits

IV Area of Concentration
Selection of courses from broad areas such as languages, communications, art, music, social studies, sciences, mathematics, physical education, home economics, and the disadvantaged child. Student must select from one area

V Electives

VI Physical Education

VII Orientation
- Lib 101 Library Instruction  R
- El Ed 100. Freshman Orientation  R
- El Ed 200 Sophomore Orientation  R
- El Ed 300 Transfer Orientation  R

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, drafting, contracting and construction, maintenance or production.

Total credits required, 192.

For additional information see Index.

I General Education

A Physical Science and Mathematics
- Chem 101, 102 General Chemistry  8 Credits
- Math 101 Algebra and Trigonometry  5 Credits
- Math 104 Finite Mathematics  5 Credits
- Phys 111 General Physics  4 Credits

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, drafting, contracting and construction, maintenance or production.

Total credits required, 192.

For additional information see Index.
### B Social Studies
- Econ 241, 242 Principles of Economics: 6 Credits
- Pol S 215 American Government: 3 Credits
- Psych 101 Introduction to Psychology: 3 Credits
- Soc 134 Introduction to Sociology: 3 Credits

### C Biological Science
- Biol 101 Principles of Biology: 3 Credits
- Zool 155 Human Physiology and Anatomy: 5 Credits
- Electives: 1 Credit

### D Humanities
- History: 6 Credits
- Electives: 3 Credits

### E Communicative Arts
- Engl 104, 105 Language in Composition and Reading: 8 Credits
- Sp 211 Fundamentals of Speech: 3 Credits
- Electives: 4 Credits

### F Physical Education

### G Library Instruction
- Lib. 206: 1 Credit

### II Industrial Education Core
- Ed 105 Technology and Application of Finishing Materials: 3 Credits
- Ed 106 Exploration and Fundamental Fabrication of Wood: 3 Credits
- Ed 110 Introduction to Industrial Education: 3 Credits
- Ed 121 Drafting I: 3 Credits
- Ed 122 Drafting II: 3 Credits
- Ed 123 Drafting III: 3 Credits
- Ed 205 Advanced Techniques of Wood Fabrication: 3 Credits
- Ed 220 Industrial Arts Design: 3 Credits
- Ed 234 Basic Metal Processes: 3 Credits
- Ed 236 Machine Metals I: 3 Credits
- Ed 251 Electricity I: 3 Credits
- Ed 253 Electricity II: 3 Credits
- Ed 260 Introduction to Power Mechanics: 3 Credits
- Ed 261 Fundamentals of Internal Combustion Engines: 3 Credits
- Ed 262 Introduction to the Automobile: 3 Credits
- Ed 310 School Shop Safety Education: 3 Credits
- Ed 357 Electronics I: 3 Credits
- Ed 360 Shop Planning and Organization: 3 Credits
- A E 359 Machine Construction: 3 Credits
- Arch 334 Drawing I: 2 Credits

### Note
Students entering industrial education as freshmen will generally enroll for the following courses: Ed 105, 106, 110, 121, 122, 123, 205, 220, 234, Engl 104, 105, Math 101, 104, and physical education.

### III. Options

#### A Teaching Option
- **1 Required**
  - Ed 204 Foundations of American Education: 3 Credits
  - Ed 305A Methods of Teaching: 3 Credits
  - Ed 305B Methods of Teaching: 1 Credit
  - Ed 426 Principles of Secondary Education: 3 Credits
- **Ed 308 Modern Materials, Design and Construction (3 cr )**
- **Ed 324 Teaching Secondary School Drawing (3 cr )**
- **Ed 336 Machine Metals II (3 cr )**
- **Ed 370 Introduction to Industrial Plastics (3 cr )** 6 Credits required

Total Credits: 62

**9-21 Credits**

**6 Credits**

**3 Credits**

**5 Credits**

**1 Credit**
I. Ed. 415. Methods of Teaching Industrial Arts 3 Credits
I. Ed. 416. Observation and Supervised Student Teaching in Industrial Education 3-12 Credits
I. Ed. 514. Foundations of Vocational and Technical Education 3 Credits
Psych 230. Developmental Psychology 3 Credits
Psych 333. Educational Psychology 3 Credits

2 Electives 6-12 Credits

B Industrial Option
1 Required
Com S. 214. Introduction to Computer Organization and Programming 3 Credits
Econ. 305. Labor Economics and Labor Relations 3 Credits
Engl 404. Business Correspondence (2 cr) 2 Credits
Engl 414. Writing of Reports and Technical Papers (3 cr) 3 Credits
1 Ad. 371. Industrial Accounting 3 Credits
1 Ed. 250. Introduction to Industrial Education 4 Credits
Math 110. Analytic Geometry and Calculus I (5 cr) 5 Credits
Stat. 201. Principles of Statistics (5 cr) 5 Credits
Psych 201. Learning and Motivation 3 Credits
Psych 450. Industrial Psychology I 3 Credits
Sp 312. Business and Professional Speaking (3 cr) 3 Credits
Sp 334A. Persuasion (3 cr) 3 Credits
Sp 336A. Group Discussion (3 cr) 3 Credits

2 Electives 6 Credits
Students are encouraged to select electives from the following subject matter areas:

Architecture
Computer Science
Economics
English
Forestry
Industrial Administration
Industrial Engineering
Industrial Psychology
Mathematics
Physics
Psychology
Speech and Telecommunicative Arts
Technical Journalism
The engineer occupies a unique and a most important position in our modern civilization. He has the responsibility of 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 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. Programs are available in the College of Engineering whereby students who graduate from such programs in the upper half of their classes may receive the B.S. degree in engineering operations after a minimum of an additional 145 credits of work in that curriculum. These programs are arranged after consultation with a student adviser in engineering operations and with the approval of the department head.
Curricula in College of Engineering

Aerospace Engineering
Agricultural Engineering
Biomedical Engineering
Ceramic Engineering
Chemical Engineering
Civil Engineering
Electrical Engineering
Engineering Mechanics
Engineering Science
Industrial Engineering
Mechanical Engineering
Metallurgy
Nuclear Engineering

Professional Engineering Curricula

4 yr. reg. & 5 yr. Co-op, B.S.
4 yr. reg. & 5 yr. Co-op, B.S.
(graduate only)
4 yr. reg. & 5 yr. Co-op, B.S.
4 yr. reg. & 5 yr. Co-op, B.S.
4 yr. reg. & 5 yr. Co-op, B.S.
4 yr. B.S.
4 yr. reg. & 5 yr. Co-op, B.S.
4 yr. reg. & 5 yr. Co-op, B.S.
4 yr. B.S.
(graduate only)

Graduate Programs

M. Eng., M.S., Ph.D.
M. Eng., M.S., Ph.D.
M. Eng., M.S., Ph.D.
M. Eng., M.S., Ph.D.
M. Eng., M.S., Ph.D.
M. Eng., M.S., Ph.D.
M. S., Ph.D.
M. Eng., M.S., Ph.D.
M. Eng., M.S., Ph.D.
M. S., Ph.D.

Related Curricula

Architecture
Building Construction
Engineering Operations

4 yr. B.A.
4 yr. reg. & 5 yr. Co-op, B.S.
4 yr. reg. & 5 yr. Co-op, B.S.

4 yr. reg. & 5 yr. Co-op, B.S.

6 yr. M. Arch.

(undergraduate only)

(undergraduate only)

Engineering Technology

Chemical Industries Technology
Construction Technology
Electronics Technology
Mechanical Technology

6 qtr. reg., Assoc. in App. Sci.
6 qtr. reg., Assoc. in App. Sci.

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 and humanities.

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 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 baccalaureate degree in minimum time will find it desirable to determine his major department as soon as possible.

The basic program includes 1

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mathematics 103, 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 102A</td>
<td>4</td>
</tr>
<tr>
<td>Physics 221</td>
<td>5</td>
</tr>
<tr>
<td>Engineering Problems (E 108)</td>
<td>1</td>
</tr>
<tr>
<td>Engineering Seminars (Engr 114, 115, 100)</td>
<td>R</td>
</tr>
<tr>
<td>Library 102</td>
<td>R</td>
</tr>
<tr>
<td>Department Designated Requirement</td>
<td>6 (minimum)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>45 (minimum)</strong></td>
</tr>
</tbody>
</table>

1Students who are not adequately prepared may have to take Math 101 and/or Chem 101 in addition to the courses listed above. Neither Math. 101 nor Chem. 101 may be used to satisfy elective requirements of the various engineering curricula. Students who begin with Math 101 will take E 104 and 105 in place of E 108.

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 three 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 six credits of Basic ROTC and up to six 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.

**Curriculum in Aerospace Engineering**

Leading to the degree Bachelor of Science. Total credits required, 197, 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>
</tr>
</tbody>
</table>

**Sophomore Year**

- Aerodynamics I
  - Aer E 244
- Analytic Geometry and Calculus III
  - Math 112
- Metallurgy for Engineers
  - Met 231
- Introduction to Computer Organization and Programming
  - Com S 214
- Fundamentals of Speech
  - Sp. 211

- Aerodynamics II
  - Aer E 245
- Analytic Geometry and Calculus IV
  - Math 213
- Statics of Engineering
  - E M 274
- Introduction to Classical Physics
  - Phys. 223
- Aerospace Laboratory
  - Aer E 271
- Socio-Humanistic Elective

16

**Junior Year**

- Stress Analysis and Materials
  - Aer. E 320
- Aerospace Laboratory
  - Aer. E 371
- Introduction to Applied Mathematics
  - Math 322
- Particle Dynamics
  - E M 345
- Introduction to Circuits and Instruments
  - E E 441
- Socio-Humanistic Elective

- Structural Analysis
  - Aer E 321
- Aerospace Laboratory
  - Aer E 372
- Stability and Control I
  - Aer E 343
- Flight Mechanics I
  - Aer E 352
- Introduction to Circuits and Instruments
  - E E 442
- Rigid Body Dynamics
  - E M 346

18

- Performance of Aerospace Vehicles
  - Aer E 246
- Introduction to Applied Mathematics
  - Math 321
- Mechanics of Materials I
  - E M 325
- Thermodynamics I
  - M E 321
- Aerospace Laboratory
  - Aer E 272
- Socio-Humanistic Elective

18

- Reaction Propulsion I
  - Aer E 309
- Aerospace Laboratory
  - Aer E 373
- Stability and Control II
  - Aer E 344
- Flight Mechanics II
  - Aer E 353
- Aerospace Instrumentation
  - Aer E 331
- Socio-Humanistic Elective

17

- Reaction Propulsion I
  - Aer E 309
- Aerospace Laboratory
  - Aer E 373
- Stability and Control II
  - Aer E 344
- Flight Mechanics II
  - Aer E 353
- Aerospace Instrumentation
  - Aer E 331
- Socio-Humanistic Elective

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1 These courses are to be chosen from the department-approved list of socio-humanistic electives. Pol. S. 215 must be among the courses selected.

2 These technical electives are to be selected from the option sequences: Aerodynamics (Aer E. 442, 443), Flight Mechanics (Aer E. 452, 453), Propulsion (Aer E. 413, 415), Structures (Aer E. 421, 423, 480), Systems (Aer E. 432, 433); Hydrospace (Aer E. 455, 456); Design (Aer E. 463).

3 This technical elective may be chosen from any of the engineering or science disciplines.
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 Work-Study Programs

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1In the junior and senior years the student will elect one of the options and take the courses listed in the selected option

2Socio-humanistic sequences are to be chosen from the department-approved list
### Electric Power and Processing

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<td>Refrigeration and Air Conditioning</td>
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<td>Particle Dynamics</td>
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### Soil and Water Control

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### Structures and Environment

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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 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 non-professional degree. It consists of a two-year pre-architecture program (94 credits), and a two-year undergraduate architectural program (102 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, 196, 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. The year in industry satisfies in part the internship requirements for professional licensing.

Ninety credits subsequent to the degree Bachelor of Arts are required to attain the degree Master of Architecture.

Pre-Architecture Program

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1 Not in architecture. Choose a balanced distribution of courses from social studies, humanities, and physical and biological sciences approved by the head of the Department of Architecture.

2 Pre-architecture 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.
## Undergraduate Architecture Program

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**Notes:**

1. Not in architecture. Choose a balanced distribution of courses from social studies, humanities, and physical and biological sciences approved by the head of the Department of Architecture.

2. Professional Elective: A sequence of courses, relevant to professional development, approved by the student's adviser and the department head.
### Professional Program

A graduate program leading to the degree Master of Architecture. Credits required for graduation, 90.

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| Arch 611      | Arch 612                | Arch 613                  | 7        | 7                    |
| Elective      | Elective                | Elective                 | 3        | 3                    |
| Professional Elective | Professional Elective | Professional Elective | 3        |                      |

| 15           | 15                      | 15                        |

#### Sixth Year

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| 15           | 15                      | 15                        |

1Professional Elective  A sequence of courses relevant to professional development, approved by the student’s adviser and the department head.
Curriculum in Building Construction

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.

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<td>Construction Planning and Scheduling</td>
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1 Or I E 480
2 Select from the department-approved list of socio-humanistic sequences
3 Technical electives must be submitted to the department for approval
## Curriculum in Ceramic Engineering

Leading to the degree Bachelor of Science. Total credits required, 192, plus physical education.

See also Basic Program

### FALL QUARTER

<table>
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<td>Technical Electives</td>
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### Sophomore Year

- **Ceramic Materials**
  - Cer E 221
- **Analytic Geometry and Calculus III**
  - Math 112
- **Introduction to Classical Physics**
  - Phys 222
- **Technical Electives**
  - Seminar
  - Cer E 201
- **High Temperature Processes**
  - Cer E 341
- **Microstructure of Ceramic Materials**
  - Cer E 351
- **Principles of Economics**
  - Econ 241
- **Physical Chemistry**
  - Chem 321
- **AC and DC Circuits**
  - E E 441
- **Seminar**
  - Cer E 301
- **Vitreous State**
  - Cer E 342
- **Colloid Chemistry of Ceramic Materials**
  - Cer E 362
- **Principles of Economics**
  - Econ 242
- **Physical Chemistry**
  - Chem 322
- **Mechanics of Materials I**
  - E M 325
- **Seminar**
  - Cer E 302
- **Electronic Ceramics**
  - Cer E 343
- **Physical Property Measurements**
  - Cer E 353
- **Heat Transfer**
  - M E 325
- **Physical Chemistry**
  - Chem 323
- **Electronic Circuits**
  - E E 445
- **Inspection Trip**
  - Cer E 300
- **Seminar**
  - Cer E 303
- **Wiring of Reports and Technical Papers**
  - Engl 414
- **Seminar**
  - Cer E 403
- **Senior Year**
  - Cer E 411
  - Senior Project
  - Cer E 431
  - Technical Electives
  - Socio-Humanistic Electives
  - Seminar
  - Cer E 401
  - Ceramic Materials Processing
  - Cer E 412
  - Senior Project
  - Cer E 432
  - Ceramic Engineering Design
  - Cer E 422
  - Socio-Humanistic Electives
  - Thermodynamics
  - Met 421
  - Seminar
  - Cer E 402
  - Ceramic Industries III
  - Cer E 413
  - Senior Project
  - Cer E 433
  - Ceramic Engineering Design
  - Cer E 423
  - Socio-Humanistic Electives
  - Writing of Reports and Technical Papers
  - Engl 414
  - Seminar
  - Cer E 403
- **Socio-humanistic electives must be department approved.** Pol S 215 will be among the courses elected.
Curriculum in Chemical Engineering

Leading to the degree Bachelor of Science.
Total credits required, 199, plus physical education.
See also Basic Program

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<td>Chemical Engineering Design</td>
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¹ Advanced ROTC credit may be substituted for this
² These electives are to be chosen from the department-approved list of socio-humanistic electives
³ Math 322 may be substituted for this
⁴ E M 325, 326, 345, 346 or any Electrical Engineering course
## Curriculum in Civil Engineering

Leading to degree, Bachelor of Science. Total credits required, 199, plus physical education.

See also Basic Program.

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<tr>
<td>C E 212</td>
<td></td>
</tr>
<tr>
<td>Statics of Engineering</td>
<td>3</td>
</tr>
<tr>
<td>E M 274</td>
<td></td>
</tr>
<tr>
<td>R Socio Humanistic Elective</td>
<td>3</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>17</strong></td>
</tr>
</tbody>
</table>

### SPRING QUARTER

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>Mechanics of Materials</td>
<td>5</td>
</tr>
<tr>
<td>E M 324</td>
<td></td>
</tr>
<tr>
<td>Engineering Materials</td>
<td>3</td>
</tr>
<tr>
<td>E M 354</td>
<td></td>
</tr>
<tr>
<td>Route and Higher Surveying</td>
<td>3</td>
</tr>
<tr>
<td>C E 213</td>
<td></td>
</tr>
<tr>
<td>Principles of Statistics</td>
<td>3</td>
</tr>
<tr>
<td>Stat 201B</td>
<td></td>
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<tr>
<td>Socio Humanistic Elective</td>
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</tr>
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<td><strong>Total</strong></td>
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</table>

### Sophomore Year

**FALL QUARTER**

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
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<tbody>
<tr>
<td>Particle Dynamics</td>
<td>3</td>
</tr>
<tr>
<td>E M 345</td>
<td></td>
</tr>
<tr>
<td>American Government</td>
<td>3</td>
</tr>
<tr>
<td>Pol S 215</td>
<td></td>
</tr>
<tr>
<td>Introduction to Computer Organization and Program</td>
<td>3</td>
</tr>
<tr>
<td>Com S 214</td>
<td></td>
</tr>
<tr>
<td>Analysis of Statically Determinate Structures</td>
<td>3</td>
</tr>
<tr>
<td>C E 331</td>
<td></td>
</tr>
<tr>
<td>Soil Engineering</td>
<td>3</td>
</tr>
<tr>
<td>C E 360</td>
<td></td>
</tr>
<tr>
<td>Professional Development</td>
<td>3</td>
</tr>
<tr>
<td>C E 395</td>
<td></td>
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**WINTER QUARTER**

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>Mechanics of Fluids</td>
<td>4</td>
</tr>
<tr>
<td>E M 378</td>
<td></td>
</tr>
<tr>
<td>Materials Laboratory</td>
<td>3</td>
</tr>
<tr>
<td>E M 327</td>
<td></td>
</tr>
<tr>
<td>Soil and Aggregate Materials Laboratory</td>
<td>3</td>
</tr>
<tr>
<td>C E 361</td>
<td></td>
</tr>
<tr>
<td>Sanitary Engineering I</td>
<td>3</td>
</tr>
<tr>
<td>C E 425</td>
<td></td>
</tr>
<tr>
<td>Analysis of Statically Indeterminate Structures</td>
<td>4</td>
</tr>
<tr>
<td>C E 432</td>
<td></td>
</tr>
<tr>
<td>Planning of Transportation Facilities</td>
<td>3</td>
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<tr>
<td>C E 352</td>
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**JUNIOR YEAR**

<table>
<thead>
<tr>
<th>Course</th>
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<tbody>
<tr>
<td>Sanitary Engineering II</td>
<td>4</td>
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<tr>
<td>C E 426</td>
<td></td>
</tr>
<tr>
<td>Designing Transportation Facilities</td>
<td>4</td>
</tr>
<tr>
<td>C E 453</td>
<td></td>
</tr>
<tr>
<td>Reinforced Concrete Design</td>
<td>3</td>
</tr>
<tr>
<td>C E 434</td>
<td></td>
</tr>
<tr>
<td>Electives</td>
<td>7</td>
</tr>
<tr>
<td>Professional Development</td>
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<tr>
<td>C E 496</td>
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<td><strong>Total</strong></td>
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**SENIOR YEAR**

<table>
<thead>
<tr>
<th>Course</th>
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<tbody>
<tr>
<td>Sanitary Engineering II</td>
<td>3</td>
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<tr>
<td>C E 426</td>
<td></td>
</tr>
<tr>
<td>Designing Transportation Facilities</td>
<td>3</td>
</tr>
<tr>
<td>C E 453</td>
<td></td>
</tr>
<tr>
<td>Reinforced Concrete Design</td>
<td>3</td>
</tr>
<tr>
<td>C E 434</td>
<td></td>
</tr>
<tr>
<td>Electives</td>
<td>7</td>
</tr>
<tr>
<td>Professional Development</td>
<td>R</td>
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<tr>
<td>C E 496</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>17</strong></td>
</tr>
</tbody>
</table>

* Shall be chosen from department approved lists. Senior year electives shall include (1) nine credits of socio-humanistic studies, (2) 14 credits of basic sciences and engineering sciences as defined below with a minimum of five 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, similarity, systems analysis, and mechanics. One course in a life science will be permitted in this category. Students appointed to advanced ROTC may substitute six credits of advanced ROTC for six credits of technical electives.
## 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

### FALL QUARTER Credits

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction to Classical Physics</td>
<td>5</td>
</tr>
<tr>
<td>Phys 223</td>
<td></td>
</tr>
<tr>
<td>Analytic Geometry and Calculus Math 112</td>
<td>5</td>
</tr>
<tr>
<td>Introduction to Computer Organization and Programming Com S 214</td>
<td>3</td>
</tr>
<tr>
<td>Principles of Economics Econ 242</td>
<td>3</td>
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<tr>
<td><strong>Total</strong></td>
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</table>

### WINTER QUARTER Credits

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electric Circuits I</td>
<td>4</td>
</tr>
<tr>
<td>E E 211</td>
<td></td>
</tr>
<tr>
<td>Electrical Instrumentation and Experimentation I</td>
<td>4</td>
</tr>
<tr>
<td>E E 231</td>
<td></td>
</tr>
<tr>
<td>Elementary Differential Equations Math 213</td>
<td>3</td>
</tr>
<tr>
<td>Statics of Engineering E M 274</td>
<td>3</td>
</tr>
<tr>
<td>American Government Pol S 215</td>
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### SPRING QUARTER Credits

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
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<tbody>
<tr>
<td>Electric Circuits II</td>
<td>3</td>
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<tr>
<td>E E 301</td>
<td></td>
</tr>
<tr>
<td>Electrical Instrumentation and Experimentation II</td>
<td>3</td>
</tr>
<tr>
<td>E E 232</td>
<td></td>
</tr>
<tr>
<td>Introduction to Applied Mathematics I Math 321</td>
<td>2</td>
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<tr>
<td>Electric and Magnetic Field Theory I E E 313</td>
<td>4</td>
</tr>
<tr>
<td>Particle Dynamics E M 345</td>
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<td><strong>Total</strong></td>
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### Sophomore Year

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>Modern Physics Phys 301</td>
<td>3</td>
</tr>
<tr>
<td>Electronics Engineering E E 374</td>
<td>4</td>
</tr>
<tr>
<td>Electric Circuits III E E 302</td>
<td>3</td>
</tr>
<tr>
<td>Introduction to Applied Mathematics II Math 322</td>
<td>3</td>
</tr>
<tr>
<td>Electromechanical Devices E E 317</td>
<td>3</td>
</tr>
<tr>
<td>Socio-Humanistic Elective 1</td>
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</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>17</strong></td>
</tr>
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</table>

### Junior Year

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Modern Physics Phys 302</td>
<td>3</td>
</tr>
<tr>
<td>Electronics Engineering E E 375</td>
<td>4</td>
</tr>
<tr>
<td>Electric Circuits IV E E 303</td>
<td>4</td>
</tr>
<tr>
<td>Electromechanical Devices E E 317</td>
<td>4</td>
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<tr>
<td>Socio-Humanistic Elective 1</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
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### Senior Year

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>Technical Electives</td>
<td>10</td>
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<tr>
<td>Electives 2</td>
<td>3</td>
</tr>
<tr>
<td>Socio-Humanistic Elective 1</td>
<td>3</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>16</strong></td>
</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 non-technical, but must be taken from the department-approved list of electives

Students appointed to advanced military training (third and fourth year) may omit six credits from this elective group

3 All students must take at least 22 credits of electrical engineering technical electives The list below is recommended 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. Minimum credits required, 180, plus physical education.

This curriculum is designed for students who desire a knowledge of the fundamentals of management, engineering, science and human behavior, and who do not wish to pursue the more specialized engineering curricula. Graduates should find opportunities in a number of intermediate administrative areas in industry, such as engineering sales, procurement, maintenance and production.

1 Except for minimum 145 credits in Technical Institute graduates' program

Program in Engineering Journalism

A program of study is provided for those who are interested in engineering journalism. The program also leads to the degree Bachelor of Science. For particulars, consult the head of the Department of Journalism and Mass Communication. See Index, Engineering Journalism.

Program in International Service

Special training for those interested in employment overseas is provided. See Index, International Service.

Program in Engineering for Officer Education

Options are available for those students who desire to obtain a commission in the Army, Navy, or Air Force. For details, see Index, Officer Education.

Those electing the program in engineering for officer education may substitute advanced officer education credits for 15 credits from the management group and three credits from the supporting group.

Students not completing the officer education program will be limited to six credits of advanced ROTC (applied to management and/or supporting groups.)

Program for Technical Institute Graduates

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. Such a student normally works for his degree in engineering operations and his program is arranged in consultation with his advisor in engineering operations and approved by the department head. For graduation, the student must fulfill all of the normal requirements of the bachelor's program. Part of the credits can be earned through advanced standing examinations, but at least an additional 145 credits must be earned subsequent to graduation from an engineering technology program. This usually requires three years.
## Required Courses

<table>
<thead>
<tr>
<th>Basic Sciences</th>
<th>204 Colleges and Curricula</th>
</tr>
</thead>
<tbody>
<tr>
<td>Math 103, 110, 111, 112</td>
<td>20</td>
</tr>
<tr>
<td>Chem 101, 102</td>
<td>8</td>
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<tr>
<td>Phys 221, 222, 223</td>
<td>15</td>
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<td>43</td>
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</table>

<table>
<thead>
<tr>
<th>Socio-Humanistic Courses</th>
<th>204 Colleges and Curricula</th>
</tr>
</thead>
<tbody>
<tr>
<td>Psych 101</td>
<td>3</td>
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<tr>
<td>Econ 241, 242</td>
<td>6</td>
</tr>
<tr>
<td>Pol S 215</td>
<td>3</td>
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<td>12</td>
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<table>
<thead>
<tr>
<th>Communication Skills</th>
<th>204 Colleges and Curricula</th>
</tr>
</thead>
<tbody>
<tr>
<td>E Gr 161, 162</td>
<td>6</td>
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<tr>
<td>Engl 104, 105</td>
<td>8</td>
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<tr>
<td>Sp 211 Engl 414</td>
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<table>
<thead>
<tr>
<th>Miscellaneous</th>
<th>204 Colleges and Curricula</th>
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<tbody>
<tr>
<td>I E 108, 109</td>
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<tr>
<td>I E 480 or I Ad 365A</td>
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<tr>
<td>I Ad 384</td>
<td>4</td>
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<tr>
<td>Lib 102, Engr 114, 115(100)</td>
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<tr>
<td>I E 293, 393</td>
<td>R</td>
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<td></td>
<td>9</td>
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</table>

## 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>Minimum Credits</th>
<th>204 Colleges and Curricula</th>
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</thead>
<tbody>
<tr>
<td>Engineering</td>
<td>204 Colleges and Curricula</td>
</tr>
<tr>
<td>Science,</td>
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<tr>
<td>engineering</td>
<td></td>
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<tr>
<td>mechanics</td>
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<td>9. electrical</td>
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</tr>
<tr>
<td>engineering</td>
<td></td>
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<tr>
<td>8. measurements</td>
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</tr>
<tr>
<td>3</td>
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<tr>
<td>Total program</td>
<td>204 Colleges and Curricula</td>
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<tr>
<td>(minimum)</td>
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<tr>
<td>180</td>
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</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

<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>Analytic Geometry and Calculus</td>
<td>Math 112</td>
<td>5</td>
<td>Elementary Differential Equations</td>
<td>Math 213</td>
<td>3</td>
</tr>
<tr>
<td>Introduction to Classical Physics</td>
<td>Phys 223</td>
<td>5</td>
<td>Energy Sources and Utilization</td>
<td>E Sci 211</td>
<td>3</td>
</tr>
<tr>
<td>Physical Chemistry</td>
<td>Chem 321</td>
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<td>Physical Chemistry</td>
<td>Chem 322</td>
<td>3</td>
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<tr>
<td>Foreign Language</td>
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<td>Foreign Language</td>
<td>Statics of Engineering</td>
<td>E M 274</td>
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<tr>
<td>****</td>
<td>17</td>
<td>****</td>
<td>16</td>
<td>****</td>
<td>16</td>
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<tr>
<td><strong>Junior Year</strong></td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Introduction to Applied Mathematics</td>
<td>Math 322</td>
<td>3</td>
<td>Engineering Materials</td>
<td>E Sci 351</td>
<td>4</td>
</tr>
<tr>
<td>Particle Dynamics</td>
<td>E M 345</td>
<td>3</td>
<td>Mechanics of Fluids</td>
<td>E M 378</td>
<td>4</td>
</tr>
<tr>
<td>Introduction to Circuits and Instruments</td>
<td>E E 441</td>
<td>4</td>
<td>Electronic Circuits, Instruments and Systems</td>
<td>E E 445</td>
<td>3</td>
</tr>
<tr>
<td>Modern Physics</td>
<td>Phys 301</td>
<td>3</td>
<td>Modern Physics</td>
<td>Phys 302</td>
<td>3</td>
</tr>
<tr>
<td>Socio-Humanistic Elective</td>
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<td>Socio Humanistic Elective</td>
<td>3</td>
<td>American Government</td>
<td>Pol S 215</td>
</tr>
<tr>
<td>****</td>
<td>16</td>
<td>****</td>
<td>18</td>
<td>****</td>
<td>17</td>
</tr>
<tr>
<td><strong>Senior Year</strong></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Engineering Analysis</td>
<td>E Sci 481</td>
<td>4</td>
<td>Engineering Analysis</td>
<td>E Sci 482</td>
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<td>Elective</td>
<td>3</td>
<td>Engineering Design</td>
<td>E Sci 491</td>
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<tr>
<td>Mass Transport Operations</td>
<td>Ch E 454</td>
<td>3</td>
<td>Introduction to Computer Organization and Programming</td>
<td>Com S 214</td>
<td>3</td>
</tr>
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<td>Socio-Humanistic Elective</td>
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<td>Socio-Humanistic Elective</td>
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<td>****</td>
<td>17</td>
<td>****</td>
<td>16</td>
<td>****</td>
<td>17</td>
</tr>
</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.

May be omitted by students in advanced ROTC.
Curriculum in Industrial Engineering

Leading to the degree Bachelor of Science. Total credits required, 194, plus physical education.

See also Cooperative Programs and 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>
</tr>
</tbody>
</table>

**Sophomore Year**

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Analytic Geometry and Calculus III</td>
<td>5</td>
</tr>
<tr>
<td>Math 112</td>
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</tr>
<tr>
<td>Metallurgy for Engineers</td>
<td>3</td>
</tr>
<tr>
<td>Met 231</td>
<td></td>
</tr>
<tr>
<td>Introduction to Industrial</td>
<td>4</td>
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<tr>
<td>Engineering</td>
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<tr>
<td>I E 250</td>
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</tr>
<tr>
<td>Introduction to Classical Physics</td>
<td>5</td>
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**Junior Year**

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<td>Math 304</td>
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<td>American Government</td>
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<td>Pol S 215</td>
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<td>Math 305</td>
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<td>Statistical Application of Digital</td>
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<td>Computers</td>
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<td>Industrial Accounting</td>
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<td>I Ad 371</td>
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<td>Socio-Humanistic Elective Elective</td>
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<td>Industrial Engineering Elective</td>
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<td>I E 441</td>
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<td>Manpower Management</td>
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<td>I E 424</td>
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<tr>
<td>Thermodynamics</td>
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<td>M E 321 (3 cr)</td>
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<td>or Phys 304 (3 cr)</td>
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<tr>
<td>Writing of Reports and</td>
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<td>Technical Papers</td>
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<td>Engl 414</td>
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These electives are to be chosen as sequences with advance approval from department authorized lists

Industrial Engineering electives are to be chosen from the following 407, 416, 420, 421, 425, 426, 443, 448, 462, 480

This elective can be from either the socio-humanistic list or the industrial engineering group.
### Curriculum in Mechanical Engineering

Leading to the degree Bachelor of Science. Total credits required, 198, plus physical education.

See also Cooperative Programs and Basic Program

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<thead>
<tr>
<th>FALL QUARTER</th>
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<th>SPRING QUARTER</th>
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<tbody>
<tr>
<td><strong>Sophomore Year</strong></td>
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<tr>
<td>Analytic Geometry and Calculus III</td>
<td>Analytic Geometry and Calculus IV</td>
<td>Introduction to Applied Mathematics I</td>
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<tr>
<td>Math 112</td>
<td>Math 213</td>
<td>Math 321</td>
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<td>Phys 223</td>
<td>E M 274</td>
<td>E M 325</td>
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<td>American Government</td>
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<td>Pol S 215</td>
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<td>Writing of Reports and Technical Papers</td>
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<td>I E 304</td>
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<td>Manufacturing Processes I</td>
<td>Manufacturing Processes II</td>
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<td>M E 332</td>
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<td>E M 326</td>
<td>M E 424</td>
<td>M E 420</td>
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<td>E M 346</td>
<td>M E 322</td>
<td>M E 323</td>
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<td>Thermodynamics I</td>
<td>AC and DC Circuits</td>
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1 Socio-humanistic electives are to be chosen from the department-approved sequences

2 May be omitted by students appointed to advanced ROTC

3 Technical 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.

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<tr>
<td><strong>Sophomore Year</strong></td>
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<td>Principles of Materials Science</td>
<td>Extractive Metallurgy</td>
<td>Metal Processing</td>
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<td>Met 230</td>
<td>Met 201</td>
<td>Met 203</td>
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<tr>
<td>Analytic Geometry and Calculus III</td>
<td>Analytic Geometry and Calculus IV</td>
<td>Metallurgy Laboratory</td>
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<td>Math 112</td>
<td>Math 213</td>
<td>Met 205</td>
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<td>Introduction to Classical Physics</td>
<td>Mathematics, Statistics, or</td>
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<td>Phys 222</td>
<td>Phys 223</td>
<td>Computer Science Elective</td>
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<td>Statics of Engineering</td>
<td>Mechanics of Materials I</td>
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<td>E M 274</td>
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<td><strong>Credits</strong></td>
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<tr>
<td>17</td>
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| **Junior Year** | | |
| Physical Metallurgy | Physical Metallurgy | Physical Metallurgy |
| Met 301 | Met 302 | Met 303 | 4 |
| Physical Metallurgy Laboratory | Physical Metallurgy Laboratory | |
| Met 305 | Met 306 | Met 307 | 2 |
| Metallurgy Seminar | Metallurgy Seminar | Metallurgy Seminar |
| Met 300 | Met 300 | Met 300 | 1 |
| Physical Chemistry | Metallurgical Thermochemistry | Chemical Metallurgy |
| Chem 321 | Met 360 | Met 361 | 3 |
| American Government | Technical Elective | Technical Elective |
| Pol S 215 | Met 307 | Met 307 | 3 |
| Socio-Humanistic Elective | Socio-Humanistic Elective | Socio-Humanistic Elective | 3 |
| | | | |
| **Credits** | **Credits** | **Credits** |
| 16 | 16 | 16 |

| **Senior Year** | | |
| Engineering Metallurgy | Engineering Metallurgy | Metallurgical Engineering Design |
| Met 401 | Met 402 | Met 433 | 3 |
| Modern Physics | Modern Physics | Modern Physics |
| Phys 301 | Phys 302 | Phys 303 | 3 |
| Introduction to Circuits and Instruments | Electronic Circuits, Instruments | Elective |
| E E 441 | and Systems | | 3 |
| | E E 445 | Technical Elective | 3 |
| | Technical Elective | Technical Elective | 3 |
| | Socio Humanistic Elective | Socio Humanistic Elective | 3 |
| | | | |
| **Credits** | **Credits** | **Credits** |
| 16 | 16 | 15 |

These electives are to be selected with the approval of the adviser.

**Technical electives must include three credits in metallurgy and three 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 an education 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 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 so that registration can be completed by mail before students return to the campus.

Curricula in Home Economics

<table>
<thead>
<tr>
<th>CURRICULA</th>
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<tr>
<td>Applied Art</td>
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<td>Art Education</td>
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<td>General Applied Art and Crafts</td>
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<td>Community Nutrition</td>
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<td>Dietetics</td>
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<td>Food Science</td>
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<td>Food and Nutrition and Related Science</td>
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<td>International Service</td>
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<td>Home Economics Journalism</td>
<td>Home Economics Journalism</td>
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<tr>
<td>Institution Management</td>
<td>College Food and Housing Administration</td>
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<tr>
<td></td>
<td>Restaurant Management</td>
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<td>School Food Service</td>
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<td>Physical Education for Women</td>
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<td></td>
<td>Textiles and Clothing and Related Science</td>
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</table>
Cooperative Program

The College of Home Economics has cooperative programs with Morningside, Westmar and Central colleges. A student may take two years at any 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 foundation as well as breadth of education of students in the College of Home Economics is provided by a group of required courses known as the core curriculum and by freedom to elect courses of a general nature.

The following courses in the core curriculum are required of all students in the College of Home Economics, except those who choose a major in related science combined with food and nutrition, or textiles and clothing, those who choose the curriculum in physical education for women, and men who choose a major within the Institution Management Department.

Each student must complete credits as listed below, unless otherwise specified in a particular curriculum. Wherever the semicolon appears in this list, it means "and/or."

| I. Home Economics | 103, F & E 270, F & N 107, H Ec 400 and F & E 375 | 16 |
| II. Biological Sciences | Zool 155, and three credits in bacteriology, biochemistry, biology, botany, genetics or zoology | 8 |
| III. Physical Sciences and Mathematics | biochemistry, chemistry, geology, mathematics, meteorology, physics, statistics | 14-16 |
| IV. Social Sciences | Psych 101, Soc 134, Anthro 218, Econ 241, 242, Pol S 215 | 18 |
| V. Written and Spoken English | Engl 104, 105, Sp 211 | 11 |
| VI. Humanities | history, philosophy, literature, foreign languages, music (omit performing arts) | 15 |
| VII. Major area of concentration | | |

All students are required to complete six 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; F. E. 240, 254, 415, 488, 521, 522, 575; F. & N. 208, 303; I. M. 380; Soc. 364, 464; Sp. 312; T. Jl. 225.

Students in the curricula of child development, family environment and home economics for general education 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 adviser in relation to the student's educational objectives (See Child Development curriculum, Family Environment curriculum, Home Economics for General Education 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 several of the above curricula (applied art, child development, food science, home economics for general education, and textiles and clothing) which are described in the following pages. 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 majors are available in the Departments of Child Development, Family Environment, Food and Nutrition, and Textiles and Clothing. For specific requirements in relation to child development, food and nutrition, and textiles and clothing, see the respective curriculum. For requirements in family environment, contact the department head.

These majors 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, 198.

Four majors are offered to men and women in the Applied Art Department: advertising design, art education, general applied art and crafts, and interior design.

<table>
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<tr>
<th>Home Economics Core</th>
<th>16 Credits</th>
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<tbody>
<tr>
<td>A A 103 Design I</td>
<td>4 Credits</td>
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<tr>
<td>F E 270 The Individual and His Family</td>
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<tr>
<td>F E 375 Management in the Family</td>
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<tr>
<td>F &amp; N 107 Nutrition and the Family's Food</td>
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<td>H Ec 400 Professional Relations</td>
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<td>A A 100 Perspective Drawing</td>
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</tr>
<tr>
<td>A A 104 Design II</td>
<td>3 Credits</td>
</tr>
<tr>
<td>A A 107 Lettering I</td>
<td>3 Credits</td>
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<tr>
<td>A A 150 Drawing I</td>
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<tr>
<td>A A 203 Color</td>
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<td>A A 233 Watercolor</td>
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<td>A A 335 Textile Design I</td>
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<td>A A 250 Drawing II</td>
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<tr>
<td>A A 261 Interior House Design I</td>
<td>3 Credits</td>
</tr>
<tr>
<td>A A 384 Survey of Art</td>
<td>3 Credits</td>
</tr>
<tr>
<td>A A 401 Study Tour</td>
<td>1 Credit</td>
</tr>
<tr>
<td>A A 404 Seminar</td>
<td>1 Credit</td>
</tr>
<tr>
<td>A A 486 Modern Art</td>
<td>3 Credits</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Biological Sciences</th>
<th>8 Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zool 155 Elementary Human Physiology and Anatomy</td>
<td>5 Credits</td>
</tr>
<tr>
<td>Select from bacteriology, biochemistry, botany, genetics, zoology</td>
<td>3 Credits</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Physical Sciences and Mathematics</th>
<th>14 Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biochemistry, chemistry, geology, mathematics, meteorology, physics, statistics</td>
<td>16 Credits</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Social Sciences</th>
<th>18 Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anthro 218 Introduction to Cultural Anthropology</td>
<td>3 Credits</td>
</tr>
<tr>
<td>Econ 241, 242 Principles of Economics</td>
<td>6 Credits</td>
</tr>
<tr>
<td>Pol S 215 American Government</td>
<td>3 Credits</td>
</tr>
<tr>
<td>Psych 101 General Psychology I</td>
<td>3 Credits</td>
</tr>
<tr>
<td>Soc 134 Introduction to Sociology</td>
<td>3 Credits</td>
</tr>
</tbody>
</table>

Students in Art Education K-12 Program may substitute A A 324
Major in Advertising Design

This major prepares students for positions in small or large advertising agencies; for work requiring precision skills such as layout and advertising design, poster art, greeting cards and gift wrap designing, television art, packaging, store display and fashion illustration.

In addition to the curriculum requirements, the following courses are to be completed:

**Applied Art**
- A A 207 Lettering II 3 Credits
- A A 306 Advertising Design I 3 Credits
- A A 324 Figure Drawing 3 Credits
- A A 406, 407 Advertising Design II, III 6 Credits
- A A 424 Oil Painting 3 Credits
- A A 484 History of Ornament 3 Credits
- A A 485 Medieval, Renaissance and Oriental Art 3 Credits
- A A 490F Special Problems in Advertising 4 Credits

**Social Sciences**
- Psych 250 Consumer Psychology 3 Credits

**Technical Journalism**
- T JI 225 Publicity and Public Relations 3 Credits
- T JI 317 Photography 4 Credits
- T JI 325 Technical Advertising 3 Credits
- T JI 342 Layout and Design of Publications 3 Credits

**Electives**
29-31 Credits

Students electing an emphasis in fashion illustration are required to take 17 additional credits, which would reduce elective credits to 12 to 14, and should declare this intention by the first quarter of the junior year.

- A A 213 Fashion Illustration I 3 Credits
- A A 214 Fashion Illustration II 3 Credits
- A A 490G Special Problems 4 Credits
- T & C 104 Textiles 4 Credits
- T & C 454 History of Costume 3 Credits

Major in Art Education

The major in art education is planned to prepare students for teaching art in grades seven through 14. Those electing the alternate program preparing students to teach art in grades kindergarten through 12 should note options and additional requirements.

For information on all additional requirements see *Index, Education, and Applied Art. Courses and Program*.

In addition to the curriculum requirements, the following courses are to be completed.
**Applied Art**  
- AA 207 Lettering II  
- AA 306 Advertising Design I  
- AA 324 Figure Drawing  
- AA 344 Weaving I  
- AA 345 Crafts I  
- AA 393 Ceramics  
- AA 424 Oil Painting  
- AA 445 Crafts II  
- AA 446 Jewelry  
- AA 485 Medieval, Renaissance and Oriental Art  

**General Education**  
- Biological, physical, social sciences or humanities: 3 Credits  
- Communicative Arts: 3 Credits  

**Professional Education**  
- AA 416 Art Methods for the Secondary School: 3 Credits  
- AA 417 Supervised Teaching of Art in the Secondary School: 8 Credits  
- Educ 204 Foundations of American Education: 3 Credits  
- Educ 305 Methods of Teaching: 4 Credits  
- Educ 426 Principles of Secondary Education: 3 Credits  
- Psych 230 Developmental Psychology: 3 Credits  
- Psych 333 Educational Psychology: 3 Credits  

**Electives**  
- 9-11 Credits

Students who elect the alternate program as preparation to teach art in grades kindergarten through 12 must earn 204 credits and are required to take the following:

**Applied Art**  
- AA 306 Advertising Design I: 3 Credits  
- AA 345 Crafts I: 4 Credits  
- AA 393 Ceramics: 3 Credits  
- AA 424 Oil Painting: 3 Credits  

Select one of the following:  
- AA 344 Weaving I: 3 Credits  
- AA 445 Crafts II: 3 Credits  
- AA 446 Jewelry: 3 Credits  

**General Education**  
- Biological, physical, social sciences and humanities: 3 Credits  
- Communicative Arts: 3 Credits  

**Professional Education**  
- AA 415 Art Methods for the Elementary School: 3 Credits  
- AA 416 Art Methods for the Secondary School: 3 Credits  
- AA 417 Supervised Teaching of Art in the Secondary School: 8 Credits  
- AA 418 Supervised Teaching of Art in the Elementary School: 8 Credits  
- Educ 204 Foundations of American Education: 3 Credits  
- Educ 305 Methods of Teaching: 4 Credits  
- Educ 426 Principles of Secondary Education: 3 Credits  
- Ed Ed 344 Principles of Teaching in the Elementary School: 2 Credits  
- Psych 230 Developmental Psychology: 3 Credits  
- Psych 333 Educational Psychology: 3 Credits  

**CD 337 Development and Guidance in Later Childhood**  
- 3 Credits  

**Electives**  
- 14-16 Credits
Major in General Applied Art and Crafts

This major is planned for the art student who may prefer a balanced art program along with a strong emphasis in the area of crafts. A broad background in design, drawing, and art history and varied crafts media permits men or women to have shops and market quality crafts in weaving, metal, jewelry and wood, or to work in community and welfare workshops or in adult education.

In addition to the curriculum requirements, the following courses are to be completed:

Applied Art

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>AA 344</td>
<td>Weaving I</td>
<td>3</td>
</tr>
<tr>
<td>AA 345</td>
<td>Crafts I</td>
<td>4</td>
</tr>
<tr>
<td>AA 393</td>
<td>Ceramics</td>
<td>3</td>
</tr>
<tr>
<td>AA 424</td>
<td>Oil Painting</td>
<td>3</td>
</tr>
<tr>
<td>AA 435</td>
<td>Textile Design II</td>
<td>3</td>
</tr>
<tr>
<td>AA 445</td>
<td>Crafts II</td>
<td>3</td>
</tr>
<tr>
<td>AA 446</td>
<td>Jewelry</td>
<td>3</td>
</tr>
<tr>
<td>AA 484</td>
<td>History of Ornament</td>
<td>3</td>
</tr>
<tr>
<td>AA 485</td>
<td>Medieval, Renaissance and Oriental Art</td>
<td>3</td>
</tr>
<tr>
<td>AA 490C</td>
<td>Special Problems</td>
<td>5 8</td>
</tr>
</tbody>
</table>

T & C 104 Textiles | 4 Credits

Electives | 33 38 Credits

Students electing an emphasis in weaving are required to take the following courses, reducing elective credit to 27:32

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>AA 346</td>
<td>Weaving II</td>
<td>3</td>
</tr>
<tr>
<td>T &amp; C 414</td>
<td>Historic Textiles</td>
<td>3</td>
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</tbody>
</table>

Major in Interior Design

This major is for art students who plan to enter the professional field of interior design and decoration.

In addition to the curriculum requirements, the following courses are to be completed:

Applied Art

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>AA 234</td>
<td>Interior Sketching</td>
<td>3</td>
</tr>
<tr>
<td>AA 361</td>
<td>History of Furniture I</td>
<td>3</td>
</tr>
<tr>
<td>AA 362</td>
<td>History of Furniture II</td>
<td>3</td>
</tr>
<tr>
<td>AA 435</td>
<td>Textile Design II</td>
<td>3</td>
</tr>
<tr>
<td>AA 464</td>
<td>Interior Design I</td>
<td>3</td>
</tr>
<tr>
<td>AA 465</td>
<td>Interior Design II</td>
<td>3</td>
</tr>
<tr>
<td>AA 466</td>
<td>Apprenticeship</td>
<td>9</td>
</tr>
<tr>
<td>AA 467</td>
<td>Interior Design III</td>
<td>3</td>
</tr>
<tr>
<td>AA 468</td>
<td>Professional Interior Design Procedures</td>
<td>2</td>
</tr>
<tr>
<td>AA 484</td>
<td>History of Ornament</td>
<td>3</td>
</tr>
<tr>
<td>AA 490E</td>
<td>Special Problems</td>
<td>3</td>
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</table>

Textiles and Clothing

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>T &amp; C 104</td>
<td>Textiles</td>
<td>4</td>
</tr>
<tr>
<td>T &amp; C 414</td>
<td>Historic Textiles</td>
<td>3</td>
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</table>

Architecture

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>Arch 361</td>
<td>Residential Architecture</td>
<td>3</td>
</tr>
<tr>
<td>Arch 460</td>
<td>Special Problems in Architecture</td>
<td>3</td>
</tr>
</tbody>
</table>

Psych 250 Consumer Psychology | 3 Credits

Electives | 19 21 Credits
Curriculum in Child Development

Leading to degree of Bachelor of Science. Total credits required, 198. 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.

Home Economics

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>A A 103</td>
<td>Design I</td>
<td>4</td>
</tr>
<tr>
<td>C D 236</td>
<td>Principles of Child Development</td>
<td>3</td>
</tr>
<tr>
<td>C D 240</td>
<td>Literature for Children</td>
<td>4</td>
</tr>
<tr>
<td>C D 336</td>
<td>Development in Early Childhood</td>
<td>4</td>
</tr>
<tr>
<td>C D 337</td>
<td>Development and Guidance in Later Childhood</td>
<td>3</td>
</tr>
<tr>
<td>C D 366</td>
<td>Activities and Materials</td>
<td>4</td>
</tr>
<tr>
<td>C D 368</td>
<td>Study Tour</td>
<td>R</td>
</tr>
<tr>
<td>C D 460</td>
<td>Guidance of Children</td>
<td>4</td>
</tr>
<tr>
<td>C D 465</td>
<td>Seminar</td>
<td>1</td>
</tr>
<tr>
<td>F E 270</td>
<td>The Individual and His Family</td>
<td>4</td>
</tr>
<tr>
<td>F E 375</td>
<td>Management in the Family</td>
<td>4</td>
</tr>
<tr>
<td>F &amp; N 107</td>
<td>Nutrition and the Family's Food</td>
<td>4</td>
</tr>
<tr>
<td>H E 400</td>
<td>Professional Relations</td>
<td>R</td>
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Biological Sciences

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>Bact 200</td>
<td>Introductory Bacteriology I</td>
<td>3</td>
</tr>
<tr>
<td>Zool 155</td>
<td>Elementary Human Physiology and Anatomy</td>
<td>5</td>
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</table>

Social Sciences

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anthro 218</td>
<td>Introduction to Cultural Anthropology</td>
<td>3</td>
</tr>
<tr>
<td>Econ 241, 242</td>
<td>Principles of Economics</td>
<td>6</td>
</tr>
<tr>
<td>Pol S 215</td>
<td>American Government</td>
<td>3</td>
</tr>
<tr>
<td>Psych 101</td>
<td>General Psychology I</td>
<td>3</td>
</tr>
<tr>
<td>Soc 134</td>
<td>Introduction to Sociology</td>
<td>3</td>
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</tbody>
</table>

Physical Sciences and Mathematics

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>Chem 101</td>
<td>General Chemistry</td>
<td>4</td>
</tr>
<tr>
<td>Stat 201</td>
<td>Principles of Statistics</td>
<td>5</td>
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Written and Spoken English

<table>
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<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engl 104, 105</td>
<td>Language in Composition and Reading</td>
<td>8</td>
</tr>
<tr>
<td>Sp 211</td>
<td>Fundamentals of Speech</td>
<td>3</td>
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Lib 101 Library Instruction

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
</table>

Physical Education

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
</table>

Humanities

Select from history, literature, foreign language, philosophy, music (omit performing arts)

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
</table>

Nursery School/Kindergarten Education Option

Home Economics

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>C D 461</td>
<td>Curriculum and Planning for the Young Child</td>
<td>2</td>
</tr>
<tr>
<td>C D 467A</td>
<td>Supervised Teaching in Nursery School/Kindergarten</td>
<td>7</td>
</tr>
<tr>
<td>C D 467B</td>
<td>Home School Relations in Supervised Teaching</td>
<td>2</td>
</tr>
<tr>
<td>C D 467E</td>
<td>Supervised Teaching in Child Development Centers</td>
<td>8</td>
</tr>
<tr>
<td>C D 468</td>
<td>Administration of Programs for Young Children</td>
<td>3</td>
</tr>
</tbody>
</table>

Biological Sciences

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zool 358</td>
<td>Prenatal Development</td>
<td>4</td>
</tr>
</tbody>
</table>

Physical Sciences and Mathematics

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mathematics</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>Select from Chemistry, geology, mathematics, meteorology, physics, statistics</td>
<td>3</td>
<td></td>
</tr>
</tbody>
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<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
</table>

Nursery School/Kindergarten Education Option

Home Economics

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
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<tbody>
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<td>C D 461</td>
<td>Curriculum and Planning for the Young Child</td>
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<tr>
<td>C D 467B</td>
<td>Home School Relations in Supervised Teaching</td>
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</tr>
<tr>
<td>C D 467E</td>
<td>Supervised Teaching in Child Development Centers</td>
<td>8</td>
</tr>
<tr>
<td>C D 468</td>
<td>Administration of Programs for Young Children</td>
<td>3</td>
</tr>
</tbody>
</table>

Biological Sciences

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zool 358</td>
<td>Prenatal Development</td>
<td>4</td>
</tr>
</tbody>
</table>

Physical Sciences and Mathematics

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mathematics</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>Select from Chemistry, geology, mathematics, meteorology, physics, statistics</td>
<td>3</td>
<td></td>
</tr>
</tbody>
</table>
### Social Sciences
- Psych 230 Developmental Psychology: 3 Credits
- Psych 333 Educational Psychology: 3 Credits
- Additional Psychology: 6 Credits
- Soc 485 Sociology of the Family
  or
  FE 385 Family Life Patterns: 3 Credits

### Communicative Arts
- Select from English, technical journalism, or speech and telecommunicative arts: 3 Credits

### Education
- Educ 204 Foundations of American Education: 3 Credits
- Educ 305B Audio-Visual Aids: 1 Credit
- El Ed 344 Principles of Teaching in the Elementary School: 2 Credits

### Music
- Music 364 Creative Activities in Music: 3 Credits

### Electives

### Community Services for Children Option

#### Home Economics
- CD 461 Curriculum and Planning for the Young Child: 2 Credits
- CD 468 Administration of Programs for Young Children: 3 Credits
- CD 470A Participation in Group Activities for Children: 6 Credits
- CD 470B Adult-Child Relations: 2 Credits
- CD 481, 482 Group Work with Children I, II: 8 Credits

#### Physical Sciences and Mathematics
- Mathematics: 3 Credits
- Select from Chemistry, geology, mathematics, meteorology, physics, statistics: 3 Credits

#### Social Sciences
- Anthro 421 Kinship and The Family in Different Cultures: 3 Credits
- Anthro 422 Culture and Personality: 3 Credits
- Psych 230 Developmental Psychology: 3 Credits
- Psych 436 Psychology of Exceptional Children: 3 Credits
- Psych 460 Psychology of Adjustment: 4 Credits
- Soc 300 Race and Minority Group Relations: 3 Credits
- Soc 330 Social Stratification: 3 Credits
- Soc 336 Juvenile Delinquency: 3 Credits
- Soc 410 Sociology of City Life: 3 Credits
- Soc 450 Human Ecology: 3 Credits

#### Electives

### Pregraduate Study Option

#### Home Economics
- CD 464 Introduction to Child Development Research: 3 Credits

#### Physical and Biological Sciences
- Chem 102 General Chemistry: 4 Credits
- Chem 231 Elementary Organic Chemistry: 4 Credits
- B & B 301 Biochemistry: 3 Credits
- Math 104 Finite Mathematics: 5 Credits
- Math 105 Introduction to Mathematical Ideas: 4 Credits
- Zool 355 Principles of Physiology: 4 Credits
- Additional physical and biological sciences
  Select from physics, chemistry genetics, food and nutrition: 6 Credits
Social Sciences
  Anthro 422 Culture and Personality
  Psych 201 General Psychology II
  Psych 202 Sensation and Perception
  Psych 301 Experimental Psychology
  Psych 302 Experimental Psychology
  Psych 440 Psychological Measurement I
  Psych 441 Opinion, Attitude and Motivation Analysis
  Soc 202 Sociological Inquiry
  Soc 305 Social Interaction

Written and Spoken English
  Engl 414 Writing of Reports and Technical Papers

Foreign Language
  Electives

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anthro 422 Culture and Personality</td>
<td>3 Credits</td>
</tr>
<tr>
<td>Psych 201 General Psychology II</td>
<td>3 Credits</td>
</tr>
<tr>
<td>Psych 202 Sensation and Perception</td>
<td>3 Credits</td>
</tr>
<tr>
<td>Psych 301 Experimental Psychology</td>
<td>3 Credits</td>
</tr>
<tr>
<td>Psych 302 Experimental Psychology</td>
<td>3 Credits</td>
</tr>
<tr>
<td>Psych 440 Psychological Measurement I</td>
<td>3 Credits</td>
</tr>
<tr>
<td>Psych 441 Opinion, Attitude and Motivation Analysis</td>
<td>3 Credits</td>
</tr>
<tr>
<td>Soc 202 Sociological Inquiry</td>
<td>3 Credits</td>
</tr>
<tr>
<td>Soc 305 Social Interaction</td>
<td>3 Credits</td>
</tr>
<tr>
<td>Engl 414 Writing of Reports and Technical Papers</td>
<td>3 Credits</td>
</tr>
</tbody>
</table>

27 Credits

Foreign Language

8 Credits

21 Credits
## Curriculum in Family Environment

Leading to the degree Bachelor of Science. Total credits required, 198.

This curriculum is designed for the student desiring a broad-based education within home economics which has an integrated and interdisciplinary focus on the family as and in environment. The field of family environment includes consumer economics, home management, family relations, household equipment, housing and family environment and related science. The curriculum requirements are

### Home Economics

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>F E 103</td>
<td>Design I</td>
<td>4</td>
</tr>
<tr>
<td>F E 185</td>
<td>Orientation to Family Environment</td>
<td>3</td>
</tr>
<tr>
<td>F E 240</td>
<td>Introduction to Family Housing</td>
<td>3</td>
</tr>
<tr>
<td>F E 254</td>
<td>Equipment in the Home</td>
<td>3</td>
</tr>
<tr>
<td>F E 270</td>
<td>The Individual and His Family</td>
<td>4</td>
</tr>
<tr>
<td>F E 375</td>
<td>Management in the Family</td>
<td>4</td>
</tr>
<tr>
<td>F E 385</td>
<td>Family Life Patterns</td>
<td>3</td>
</tr>
<tr>
<td>F &amp; N 107</td>
<td>Nutrition and the Family’s Food</td>
<td>4</td>
</tr>
<tr>
<td>H Ec 400</td>
<td>Professional Relations</td>
<td>R</td>
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</table>

### Biological and Physical Sciences

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Math 105, 104, 101 or 190 and 191 or 101B and 101C</td>
<td>4.6</td>
<td></td>
</tr>
<tr>
<td>Chem 101</td>
<td>General Chemistry</td>
<td>4</td>
</tr>
<tr>
<td>Phys 106</td>
<td>Elementary Physics</td>
<td>4</td>
</tr>
<tr>
<td>Zool 155</td>
<td>Elementary Human Physiology</td>
<td>5</td>
</tr>
<tr>
<td>Select from botany, zoology, bacteriology or genetics</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Select from geology, meteorology, chemistry or physics</td>
<td>3</td>
<td></td>
</tr>
</tbody>
</table>

### Humanities

Select from music, foreign language, philosophy, literature and/or history. If a foreign language is chosen, at least two courses must be taken in one language. 15 Credits

### Social Sciences

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anthro 218</td>
<td>Introduction to Cultural Anthropology</td>
<td>3</td>
</tr>
<tr>
<td>Econ 241, 242</td>
<td>Principles of Economics</td>
<td>6</td>
</tr>
<tr>
<td>Pol S 215</td>
<td>American Government</td>
<td>3</td>
</tr>
<tr>
<td>Psych 101</td>
<td>General Psychology</td>
<td>3</td>
</tr>
<tr>
<td>Soc 134</td>
<td>Introduction to Sociology</td>
<td>3</td>
</tr>
</tbody>
</table>

### Written and Spoken English

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engl 104, 105</td>
<td>Language in Composition and Reading</td>
<td>8</td>
</tr>
<tr>
<td>Sp 211</td>
<td>Fundamentals of Speech</td>
<td>3</td>
</tr>
</tbody>
</table>

### Library Instruction

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lib 101</td>
<td>Library Instruction</td>
<td>R</td>
</tr>
</tbody>
</table>

### Physical Education

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>45 48 Credits</td>
<td></td>
</tr>
</tbody>
</table>

### Family Environment Concentration

Approximately one half of the required credits in the area will be selected from home economics. Most of the remaining will be selected from the social, physical and biological sciences, humanities and communicative arts. Some courses may be selected from fields such as architecture and urban planning.

The proportion of courses in each area and specification of courses will be jointly determined by the student and adviser in relation to the student’s educational objectives.

### Electives

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>47-52 Credits</td>
<td></td>
</tr>
</tbody>
</table>

The program in consumer economics is designed for students interested in preparing for positions which require basic understandings of consumer behavior in our economy and of conditions which influence consumption in our society. This program may be pursued through the Department of Family Environment in the College of Home Economics or the Department of Economics in the College of Sciences and Humanities. Students taking this program in economics must meet the requirements of the College of Sciences and Humanities.

The family environment and related science program is designed for qualified students interested in the basic social physical and biological sciences, mathematics, research and development and/or graduate work.

Students interested in either of these programs should contact the department head to plan a program. Several additional credits will be required in mathematics, statistics and the basic sciences.

*Undergraduate students in family environment may also choose one of the two special programs (1) consumer economics, or (2) family environment and related science.
Curriculum in Food and Nutrition

Leading to the degree Bachelor of Science. Total credits required, 198.

Four majors are offered in the Department of Food and Nutrition: 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 related science have the following courses in common. Students anticipating graduate study should select the Chemistry II sequence.

<table>
<thead>
<tr>
<th>Home Economics</th>
<th>41 Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>A A 103 Design I</td>
<td>4 Credits</td>
</tr>
<tr>
<td>F E 254 Equipment in the Home</td>
<td>3 Credits</td>
</tr>
<tr>
<td>F E 270 The Individual and His Family</td>
<td>4 Credits</td>
</tr>
<tr>
<td>F E 375 Management in the Family</td>
<td>4 Credits</td>
</tr>
<tr>
<td>F. &amp; N 107 Nutrition and the Family’s Food</td>
<td>4 Credits</td>
</tr>
<tr>
<td>F &amp; N 214, 215 Foods I, II.</td>
<td>8 Credits</td>
</tr>
<tr>
<td>F &amp; N 303 Family Meal Management</td>
<td>4 Credits</td>
</tr>
<tr>
<td>F &amp; N 305 Nutrition and Dietetics</td>
<td>4 Credits</td>
</tr>
<tr>
<td>F &amp; N. 404. Seminar in Food and Nutrition</td>
<td>2 Credits</td>
</tr>
<tr>
<td>H Ec 400. Professional Relations</td>
<td>R</td>
</tr>
<tr>
<td>I M 380. Quantity Food Production</td>
<td>4 Credits</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Biological Sciences</th>
<th>10 Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bact 304 General Bacteriology</td>
<td>5 Credits</td>
</tr>
<tr>
<td>Zool 155 Elementary Human Physiology and Anatomy</td>
<td>5 Credits</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Physical Sciences</th>
<th>22.32 Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemistry Sequence I</td>
<td>18 Credits</td>
</tr>
<tr>
<td>Chemistry 101, 102 General Chemistry</td>
<td>8 Credits</td>
</tr>
<tr>
<td>Chem 231 Elementary Organic Chemistry</td>
<td>5 Credits</td>
</tr>
<tr>
<td>B &amp; B 301 Biochemistry</td>
<td>3 Credits</td>
</tr>
<tr>
<td>B &amp; B 311 Laboratory in Biochemistry</td>
<td>2 Credits</td>
</tr>
<tr>
<td>or</td>
<td></td>
</tr>
<tr>
<td>Chemistry Sequence II</td>
<td>28 Credits</td>
</tr>
<tr>
<td>Chem 101, 102, or 101A, 102A, General Chemistry</td>
<td>8 Credits</td>
</tr>
<tr>
<td>Chem 103 Systematic Inorganic Chemistry</td>
<td>4 Credits</td>
</tr>
<tr>
<td>Chem 334, 335 Organic Chemistry</td>
<td>8 Credits</td>
</tr>
<tr>
<td>B &amp; B 304, 305 Physiological Chemistry (6 cr)</td>
<td></td>
</tr>
<tr>
<td>or</td>
<td></td>
</tr>
<tr>
<td>B &amp; B 404, 405 Survey of Biochemistry (6 cr)</td>
<td>6 Credits</td>
</tr>
<tr>
<td>B &amp; B 311 Laboratory in Biochemistry</td>
<td>2 Credits</td>
</tr>
<tr>
<td>Phys 106 Elementary Physics</td>
<td>4 Credits</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Social Sciences</th>
<th>18 Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anthro. 218 Introduction to Cultural Anthropology</td>
<td>3 Credits</td>
</tr>
<tr>
<td>Econ. 241, 242 Principles of Economics</td>
<td>6 Credits</td>
</tr>
<tr>
<td>Pol S 215 American Government</td>
<td>3 Credits</td>
</tr>
<tr>
<td>Psych 101 General Psychology</td>
<td>3 Credits</td>
</tr>
<tr>
<td>Soc 134 Introduction to Sociology</td>
<td>3 Credits</td>
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</table>

<table>
<thead>
<tr>
<th>Humanities</th>
<th>15 Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>History</td>
<td>6 Credits</td>
</tr>
<tr>
<td>Select from Philosophy, literature, foreign language, music and history</td>
<td>9 Credits</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Written and Spoken English</th>
<th>11 Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engl 104, 105 Language in Composition and Reading</td>
<td>8 Credits</td>
</tr>
<tr>
<td>Sp 211 Fundamentals of Speech</td>
<td>3 Credits</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Lib 106 Library Instruction</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical Education</td>
<td>6 Credits</td>
</tr>
</tbody>
</table>
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 the Home Economics Extension Service.

In addition to the curriculum requirements, the following courses are to be completed:

<table>
<thead>
<tr>
<th>Home Economics</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>F E 488 Family Finance</td>
<td>3</td>
</tr>
<tr>
<td>F &amp; N 400A Field Study Tour</td>
<td>R</td>
</tr>
<tr>
<td>F &amp; N 409 Diet Therapy</td>
<td>4</td>
</tr>
<tr>
<td>F &amp; N 410 Nutrition During Human Growth and Development</td>
<td>3</td>
</tr>
<tr>
<td>F &amp; N 411 Experimental Study of Foods</td>
<td>4</td>
</tr>
<tr>
<td>F &amp; N 413 Community Nutrition</td>
<td>3</td>
</tr>
<tr>
<td>F &amp; N 414 Seminar in Community Nutrition</td>
<td>2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Biological Sciences</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zool 355 Principles of Physiology</td>
<td>4</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Social Sciences</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Psych 333 Educational Psychology</td>
<td>3</td>
</tr>
<tr>
<td>Soc 364 Group Dynamics</td>
<td>3</td>
</tr>
</tbody>
</table>

| T JL 225 Publicity and Public Relations              | 3       |
| Select from CD 236 Psych 230                         | 3       |
| Electives                                           | 30-40   |

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 excellent 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 curriculum requirements, the following courses are to be completed:

<table>
<thead>
<tr>
<th>Home Economics</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>F &amp; N 400A Field Study Tour</td>
<td>R</td>
</tr>
<tr>
<td>F &amp; N 409 Diet Therapy</td>
<td>4</td>
</tr>
<tr>
<td>F &amp; N 410 Nutrition During Human Growth and Development</td>
<td>3</td>
</tr>
<tr>
<td>F &amp; N 411 Experimental Studies of Food</td>
<td>4</td>
</tr>
<tr>
<td>F &amp; N 418 Methods of Teaching Nutrition</td>
<td>3</td>
</tr>
<tr>
<td>H Ed 415 Principles of Education Applied to Home Economics</td>
<td>3</td>
</tr>
<tr>
<td>I M 484 Purchasing</td>
<td>4</td>
</tr>
<tr>
<td>I M 487 Organization and Management</td>
<td>3</td>
</tr>
<tr>
<td>I M 488 Personnel Management in Institutions</td>
<td>3</td>
</tr>
<tr>
<td>I M 485 Equipment (4 cr)</td>
<td></td>
</tr>
<tr>
<td>or</td>
<td></td>
</tr>
<tr>
<td>I M 580 Quantity Food Development (3 cr)</td>
<td></td>
</tr>
<tr>
<td>or</td>
<td></td>
</tr>
<tr>
<td>I Ad 384 General Accounting (4 cr)</td>
<td>3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Biological Sciences</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zool 355 Principles of Physiology</td>
<td>4</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Social Sciences</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Psych 333 Educational Psychology</td>
<td>3</td>
</tr>
<tr>
<td>Soc 364 Group Dynamics</td>
<td>3</td>
</tr>
<tr>
<td>T JL 225 Publicity and Public Relations</td>
<td>3</td>
</tr>
<tr>
<td>Select from CD 236 Psych 230</td>
<td>3</td>
</tr>
<tr>
<td>Electives</td>
<td>25-36</td>
</tr>
</tbody>
</table>

1 Psych 333, Educational Psychology, may be substituted for H Ed 415
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 leads to careers in business or in food research. For emphasis in food marketing and advertising it is recommended that additional courses be selected from economics, psychology and statistics.

In addition to the curriculum requirements, the following courses are to be completed:

Home Economics

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>FE 488 Family Finance</td>
<td>3</td>
</tr>
<tr>
<td>F &amp; N 320 Fundamentals of Food Measurement</td>
<td>3</td>
</tr>
<tr>
<td>F &amp; N 400B Field Study Tour</td>
<td>R</td>
</tr>
<tr>
<td>F &amp; N 410 Nutrition During Human Growth and Development or F &amp; N 413 Community Nutrition</td>
<td>3</td>
</tr>
<tr>
<td>F &amp; N 420 History of Food</td>
<td>2</td>
</tr>
<tr>
<td>F &amp; N 421, 422 Principles of Food Science I, II</td>
<td>8</td>
</tr>
<tr>
<td>F &amp; N 423 Introduction to Research in Food Science</td>
<td>3</td>
</tr>
</tbody>
</table>

Written and Spoken English

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Speech Elective</td>
<td>3</td>
</tr>
<tr>
<td>TJI 225 Publicity and Public Relations</td>
<td>3</td>
</tr>
<tr>
<td>TJI 325 Principles of Advertising</td>
<td></td>
</tr>
<tr>
<td>or</td>
<td></td>
</tr>
<tr>
<td>Engl 414 Writing of Reports and Technical Papers</td>
<td>3</td>
</tr>
</tbody>
</table>

Electives

<table>
<thead>
<tr>
<th>Courses</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Select from physical and biological sciences, economics, mathematics or statistics</td>
<td>5</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Electives</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>29-39</td>
</tr>
</tbody>
</table>

1 Students may take part of Chemistry Sequence II and complete remaining requirements in Sequence I. Sequence II fulfills option of five credits from physical and biological sciences in major.

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

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>AA 103 Design I (4 cr)</td>
<td></td>
</tr>
<tr>
<td>or</td>
<td></td>
</tr>
<tr>
<td>AA 384 Survey of Art (3 cr)</td>
<td></td>
</tr>
<tr>
<td>F &amp; N 214, 215 Foods I, II</td>
<td></td>
</tr>
<tr>
<td>F &amp; N 303 Family Meal Management</td>
<td></td>
</tr>
<tr>
<td>F &amp; N 305 Nutrition and Dietetics</td>
<td></td>
</tr>
<tr>
<td>F &amp; N 404 Seminar in Food and Nutrition</td>
<td></td>
</tr>
<tr>
<td>F &amp; N 411 Experimental Studies of Food</td>
<td></td>
</tr>
<tr>
<td>F &amp; N 415 Introduction to Nutrition Research</td>
<td></td>
</tr>
<tr>
<td>F &amp; N 409 Diet Therapy (4 cr)</td>
<td></td>
</tr>
<tr>
<td>or</td>
<td></td>
</tr>
<tr>
<td>F &amp; N 410 Nutrition During Human Growth and Development (3 cr)</td>
<td>3</td>
</tr>
<tr>
<td>or</td>
<td></td>
</tr>
<tr>
<td>F &amp; N 413 Community Nutrition (3 cr)</td>
<td></td>
</tr>
<tr>
<td>HC 400 Professional Relations</td>
<td>R</td>
</tr>
</tbody>
</table>

Select from courses in home economics other than those in major area

<table>
<thead>
<tr>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>11-12</td>
</tr>
<tr>
<td>Biological Sciences</td>
</tr>
<tr>
<td>--------------------------------</td>
</tr>
<tr>
<td>Bact 304 General Bacteriology</td>
</tr>
<tr>
<td>Zool 106, 108 General Zoology</td>
</tr>
<tr>
<td>Zool 355 Principles of Physiology</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Physical Sciences</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chem 101, 102 General Chemistry</td>
<td>8</td>
</tr>
<tr>
<td>Chem 103 Systematic Inorganic Chemistry</td>
<td>4</td>
</tr>
<tr>
<td>Chem 211 Quantitative Analysis</td>
<td>5</td>
</tr>
<tr>
<td>Chem 334, 335, 336 Organic Chemistry</td>
<td>12</td>
</tr>
<tr>
<td>B &amp; B 304, 305 Physiological Chemistry (6 cr)</td>
<td>6</td>
</tr>
<tr>
<td>or</td>
<td></td>
</tr>
<tr>
<td>B &amp; B 404, 405 Survey of Biochemistry (6 cr)</td>
<td>6</td>
</tr>
<tr>
<td>Math 101 Algebra and Trigonometry</td>
<td>5</td>
</tr>
<tr>
<td>Math 103 Pre calculus Mathematics</td>
<td>5</td>
</tr>
<tr>
<td>Math 110, 111 Analytic Geometry and Calculus I, II</td>
<td>10</td>
</tr>
<tr>
<td>Phys 111, 112 General Physics</td>
<td>8</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Social Sciences and Humanities</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pol S 215 American Government</td>
<td>3</td>
</tr>
<tr>
<td>History</td>
<td>6</td>
</tr>
<tr>
<td>Additional</td>
<td>6</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Written and Spoken English</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engl 104, 105 Language in Composition and Reading</td>
<td>8</td>
</tr>
<tr>
<td>Sp 211 Fundamentals of Speech</td>
<td>3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Physical Education</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>F L 101, 102 (Elementary French)</td>
<td>6</td>
</tr>
<tr>
<td>or</td>
<td></td>
</tr>
<tr>
<td>131, 132 (Elementary German)</td>
<td></td>
</tr>
<tr>
<td>or</td>
<td></td>
</tr>
<tr>
<td>121, 122 (Elementary Russian)</td>
<td>8</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Electives</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lib 101 Library Instruction</td>
<td>6</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>R</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Additional</td>
<td>6</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Total</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Biological Sciences</td>
<td>19</td>
</tr>
<tr>
<td>Physical Sciences</td>
<td>63</td>
</tr>
<tr>
<td>Social Sciences and Humanities</td>
<td>15</td>
</tr>
<tr>
<td>Written and Spoken English</td>
<td>11</td>
</tr>
<tr>
<td>Physical Education</td>
<td>6</td>
</tr>
<tr>
<td>Electives</td>
<td>31</td>
</tr>
</tbody>
</table>

| Total                          | 94      |
Curriculum in Home Economics Education

Leading to the degree Bachelor of Science. Total credits required, 198.

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 in the section on College of Education

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>A A 103</td>
<td>Design I</td>
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</tr>
<tr>
<td>A A 261</td>
<td>Interior House Design I</td>
<td>3</td>
</tr>
<tr>
<td>C D 236</td>
<td>Principles of Child Development</td>
<td>3</td>
</tr>
<tr>
<td>C D 337</td>
<td>Development and Guidance in Later Childhood</td>
<td>3</td>
</tr>
<tr>
<td>F E 254</td>
<td>Equipment in the Home</td>
<td>3</td>
</tr>
<tr>
<td>F E 270</td>
<td>The Individual and His Family</td>
<td>4</td>
</tr>
<tr>
<td>F E 375</td>
<td>Management in the Family</td>
<td>4</td>
</tr>
<tr>
<td>F E 488</td>
<td>Family Finance</td>
<td>3</td>
</tr>
<tr>
<td>F &amp; N 107</td>
<td>Nutrition and the Family's Food</td>
<td>4</td>
</tr>
<tr>
<td>F &amp; N 208</td>
<td>Principles of Food Preparation</td>
<td>5</td>
</tr>
<tr>
<td>F &amp; N 303</td>
<td>Family Meal Management</td>
<td>4</td>
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<tr>
<td>H Ec 400</td>
<td>Professional Relations</td>
<td>R</td>
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Home Economics

<table>
<thead>
<tr>
<th>Housing Option</th>
</tr>
</thead>
<tbody>
<tr>
<td>Select from A A 262, Arch 361, F E 240, 445, 446, 521</td>
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<table>
<thead>
<tr>
<th>Management Option</th>
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<tbody>
<tr>
<td>(Select from F E 489, I Mgt 380)</td>
</tr>
<tr>
<td>T &amp; C 104 Textiles I</td>
</tr>
<tr>
<td>T &amp; C 123 Pattern Making and Clothing Construction (5 cr)</td>
</tr>
<tr>
<td>or</td>
</tr>
<tr>
<td>T &amp; C 125 Pattern Making and Clothing Construction (4 cr)</td>
</tr>
<tr>
<td>T &amp; C 245 Clothing Selection</td>
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Area of Concentration

Select from home economics and related courses in one of the following areas: food and nutrition, housing and equipment, human development and the family, home management and family economics, or textiles and clothing.

<table>
<thead>
<tr>
<th>Professional Education</th>
</tr>
</thead>
<tbody>
<tr>
<td>Educ 204</td>
</tr>
<tr>
<td>Educ 305</td>
</tr>
<tr>
<td>Educ 426</td>
</tr>
<tr>
<td>H Ed 406</td>
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<td>H Ed 407</td>
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<td>H Ed 410</td>
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<tr>
<td>H Ed 417</td>
</tr>
<tr>
<td>Psych 230</td>
</tr>
<tr>
<td>Psych 333</td>
</tr>
</tbody>
</table>

Biological Sciences

| Zool 155             | Elementary Human Physiology and Anatomy         | 5 Credits |
| Select from bacteriology, biochemistry and biophysics, botany, genetics, or zoology | 3 Credits |

Physical Sciences

| Chem 101, 102        | General Chemistry                               | 8 Credits |
| Chem 231             | Elementary Organic Chemistry                    | 4 Credits |
| Phys 106             | Elementary Physics                              | 4 Credits |

Opportunities for supervised teaching in home economics are offered in selected Iowa schools. Plans should be made with adviser and reservations filed with department head at least four quarters before registration in the course.
Curriculum in Home Economics for General Education

Leading to the degree Bachelor of Science. Total credits required, 198.
This curriculum is designed for the student interested in home economics and in a broad education. As soon as possible after choosing a major, the student should plan with the adviser for the selection of a series of courses that will insure a well-balanced program. The curriculum requirements are:

Home Economics

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
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<tbody>
<tr>
<td>A A 103 Design I</td>
<td>4</td>
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<tr>
<td>C D 236 Principles of Child Development</td>
<td>3</td>
</tr>
<tr>
<td>F E 240 Introduction to Family Housing</td>
<td>3</td>
</tr>
<tr>
<td>F E 254 Equipment in the Home</td>
<td>3</td>
</tr>
<tr>
<td>F E 270 The Individual and His Family</td>
<td>4</td>
</tr>
<tr>
<td>F E 375 Management in the Family</td>
<td>4</td>
</tr>
<tr>
<td>F &amp; N 107 Nutrition and the Family's Food</td>
<td>4</td>
</tr>
<tr>
<td>F &amp; N 208 Foods I</td>
<td>5</td>
</tr>
<tr>
<td>H Ec 400 Professional Relations</td>
<td>R</td>
</tr>
<tr>
<td>H Ec 420A Senior Seminar</td>
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<tr>
<td>T &amp; C 104 Textiles</td>
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Biological Sciences

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>Zool 155 Elementary Human Physiology and Anatomy</td>
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Physical Sciences and Mathematics

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
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<tbody>
<tr>
<td>Chem 101, 102 General Chemistry</td>
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</tr>
<tr>
<td>Chem 231 Elementary Organic Chemistry</td>
<td>4</td>
</tr>
<tr>
<td>Select from biochemistry, geology, mathematics, meteorology, physics, statistics</td>
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Social Sciences

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anthro 218 Introduction to Cultural Anthropology</td>
<td>3</td>
</tr>
<tr>
<td>Econ 241, 242 Principles of Economics</td>
<td>6</td>
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<tr>
<td>Pol S 215 American Government</td>
<td>3</td>
</tr>
<tr>
<td>Psych 101 General Psychology I</td>
<td>3</td>
</tr>
<tr>
<td>Soc 134 Introduction to Sociology</td>
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Written and Spoken English

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
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<tbody>
<tr>
<td>Engl 104, 105 Language in Composition and Reading</td>
<td>8</td>
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<tr>
<td>Sp 211 Fundamentals of Speech</td>
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Lib 101 Library Instruction

<table>
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<th>Course</th>
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<tr>
<td>Physical Education</td>
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Electives

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<tr>
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<tr>
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<tbody>
<tr>
<td>Select from history, philosophy, literature, foreign languages, music</td>
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</tr>
</tbody>
</table>
Major in Home Economics for General Education

This major offers education in all areas of home economics and permits choice in the social sciences, physical and biological sciences, English, foreign languages or mathematics. Students may develop an individual program in an area of special interest.

In addition to the curriculum requirements the following courses are to be completed:

**Home Economics**
- A A 261 Interior House Design I 3 Credits
- Child Development 3 Credits
- F E 415 Consumer Behavior I
  - or
- F E 488 Family Finance 3 Credits
- Select from home economics courses in at least three different areas 24 Credits

**Biological Sciences**
- Select from Bact 200, 304, Biol 101 3-5 Credits

**Social Sciences**
- Select from economics, history, government, psychology, sociology, geography 15 Credits

**Humanities**
- Select from history, philosophy, literature, foreign language, music 15 Credits

**Electives**
- 40-42 Credits

Major in International Service

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 such as Peace Corps, Voluntary International Service Assignments (VISA), as well as provide an opportunity for young women to become oriented to national and international affairs as part of their responsibility of citizenship in its broadest sense. For further information see Index, International Service Programs.

In addition to the curriculum requirements the following courses are to be completed:

**Home Economics**
- A A 384 Survey of Art 3 Credits
- F & N 232 Nutrition of the Child and the Family (3 cr )
  - or
- F & N 305 Nutrition and Dietetics (4 cr ) 3-4 Credits
- Additional home economics 21-22 Credits
- Select six credits from each of the following groups 30 Credits

**Economics**
- 306 Comparative Economic Systems 3 Credits
- 411 Economics of Underdeveloped Nations 3 Credits
- 434 Land Resource Economics 3 Credits
- 455 International Economics 3 Credits
- 456 International Finance .... 3 Credits

**Geography**
- 221 Cultural Geography - European and American 3 Credits
- 222 Cultural Geography - African, Asian, Australian and Pacific 3 Credits
- 321 World Geography 3 Credits
- 322 Economic Geography 3 Credits

**History**
- 203 Western Civilization 4 Credits
- 477 A, B, C History of U S Foreign Policy 3 Credits (each)

**Political Science**
- 340 Politics of Developing Areas 3 Credits
- 351, 352, 353 World Politics and International Organization 3 Credits (each)
Sociology and Anthropology

Anthro 321 Primitive Cultures of the World 3 Credits
Anthro 425 Intercultural Relations 3 Credits
Soc 392 Adoption and Diffusion of Innovations 3 Credits
Soc 495 Sociology of Development 3 Credits

Select six credits in the study of a single non-European area

Asia
Hist 340, 341 Introduction to East Asia 3 Credits (each)
Pol S 442 A Governments of China and Japan 3 Credits
Pol S 442 B Governments of India, Pakistan and Southeast Asia 3 Credits
Hist 443 Modern Japanese History 3 Credits
Pol S 451 Asia in World Affairs 3 Credits
Phil 456 Oriental Religious Philosophy 3 Credits

Latin America
Anthro 323 The Peoples of Middle and South America 3 Credits
Anthro 325 Native Peoples of Middle and South America 3 Credits
Pol S 443 A Latin American Governments 3 Credits
Pol S 443 B Recent Latin American Politics 3 Credits
Hist 350, 351, 352 History of Latin America 3 Credits (each)
Hist 479 A, B Inter American Relations 3 Credits (each)

Russia
Hist 416 A, B, C History of Russia 3 Credits (each)
Pol S 444 Government and Politics of the Soviet Union 3 Credits
Hist 478 U.S. Soviet Relations 3 Credits

Africa and Middle East
D St 104 The African Continent, People and Culture 3 Credits
D St 105 Survey of African History 3 Credits
D St 106 Africa in World Affairs 3 Credits
Pol S 445 Politics of the Middle East 3 Credits
Pol S 446 A, 446 B Governments of Africa south of the Sahara 3 Credits (each)

Language

Electives 18 Credits

26 Credits
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: 198.

A variety of positions is open to women with combined training in home economics and journalism. Such positions include editorial, advertising, radio and television and public relations work in media 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 young women also lay foundations for active careers by contributing to magazines and newspapers and by participating in productions for the University stations WOI-AM, FM and TV.

<table>
<thead>
<tr>
<th>Home Economics</th>
<th>37 48 Credits</th>
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<tbody>
<tr>
<td>A A 103 Design I</td>
<td>4 Credits</td>
</tr>
<tr>
<td>or A A 384 Survey of Art</td>
<td>3 Credits</td>
</tr>
<tr>
<td>C D 236 Principles of Child Development</td>
<td>3 Credits</td>
</tr>
<tr>
<td>F E 240 Introduction to Family Housing</td>
<td>3 Credits</td>
</tr>
<tr>
<td>F E 270 The Individual and His Family</td>
<td>4 Credits</td>
</tr>
<tr>
<td>F E 375 Management in the Family</td>
<td>4 Credits</td>
</tr>
<tr>
<td>Additional Family Environment</td>
<td>3 Credits</td>
</tr>
<tr>
<td>F &amp; N 107 Nutrition and the Family's Food</td>
<td>4 Credits</td>
</tr>
<tr>
<td>H Ec 400 Professional Relations</td>
<td>R</td>
</tr>
<tr>
<td>H Ec 420B Senior Seminar</td>
<td>1 Credit</td>
</tr>
<tr>
<td>T &amp; C 104 Textiles</td>
<td>4 Credits</td>
</tr>
<tr>
<td>Home Economics (Concentration of a minimum of 18 credits in one area, may include required courses in that area)</td>
<td>4 15 Credits</td>
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<table>
<thead>
<tr>
<th>Technical Journalism</th>
<th>34 36 Credits</th>
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<tbody>
<tr>
<td>T Jl 101 Introduction to Mass Communication</td>
<td>2 Credits</td>
</tr>
<tr>
<td>T Jl 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</td>
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<tr>
<td>At least three 400 level courses</td>
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<table>
<thead>
<tr>
<th>Biological Sciences</th>
<th>8 10 Credits</th>
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<tbody>
<tr>
<td>Zool 155 Elementary Human Physiology and Anatomy</td>
<td>5 Credits</td>
</tr>
<tr>
<td>Bact 200 Introductory Bacteriology (3 cr)</td>
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<tr>
<td>or Bact 304 General Bacteriology (5 cr)</td>
<td>3 5 Credits</td>
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<table>
<thead>
<tr>
<th>Physical Sciences and Mathematics</th>
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<table>
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<tr>
<td>Anthro 218 Introduction to Cultural Anthropology</td>
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<tr>
<td>Econ 241, 242 Principles of Economics</td>
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<tr>
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<tr>
<td>Soc 134 Introduction to Sociology</td>
<td>3 Credits</td>
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<table>
<thead>
<tr>
<th>Humanities</th>
<th>15 Credits</th>
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<tbody>
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<td>Select from history, philosophy, literature, foreign language</td>
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</table>

<table>
<thead>
<tr>
<th>Written and Spoken English</th>
<th>11 Credits</th>
</tr>
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<tbody>
<tr>
<td>Engl 104, 105 Language in Composition and Reading</td>
<td>8 Credits</td>
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<tr>
<td>Sp 211 Fundamentals of Speech</td>
<td>3 Credits</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Lib 101 Library Instruction</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical Education</td>
<td>6 Credits</td>
</tr>
<tr>
<td>Electives</td>
<td>38 55 Credits</td>
</tr>
</tbody>
</table>

In addition to the 198 credits required for graduation, all students must fulfill the T Jl 490L professional work requirement. It involves three 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, 198.
For men selecting a major in this department, the following adjustments will be made:
Add recommended electives (8 credits); omit F. & N. 303, and F. E. 375 (total 8 credits).

The three majors within the institution management curriculum—college food and housing administration, 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 eligible for membership in related associations such as the National Association of College and University Food Services, the American School Food Service Association, and the National Restaurant Association.

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.

### Home Economics

- **A A 103 Design I** 4 Credits
- **F E 254 Equipment in the Home** 3 Credits
- **F E 270 The Individual and His Family** 4 Credits
- **F E 375 Management in the Family** 4 Credits
- **F & N 107 Nutrition and the Family's Food** 4 Credits
- **F & N 214 Foods I** 4 Credits
- **F & N 215 Foods II** 4 Credits
- **F & N 303 Family Meal Management** 4 Credits
- **H Ec 400 Professional Relations** 4 Credits
- **I M 287 Introduction to Institution Management** 2 Credits
- **I M 380 Quantity Food Production Management** 4 Credits
- **I M 400 Study Tour** 1 Credit
- **I M 404 Seminar** 2 Credits
- **I M 484 Purchasing** 4 Credits
- **I M 485 Equipment** 4 Credits
- **I Mgt 486 Institution Management Experience** 3-5 Credits
- **I M 487 Organization and Management** 3 Credits
- **I M 488 Personnel Management in Institutions** 3 Credits
- **Additional Institution Management** 3 Credits
- **T & C 104 Textiles** 4 Credits

### Concentration A

- **B & B 301 Biochemistry** 3 Credits
- **Educ 305A Methods of Teaching** 3 Credits
- **F & N 305 Nutrition and Dietetics** 4 Credits
- **F & N 411 Experimental Studies of Food** 4 Credits
- **or**
- **Concentration B**
  - **Econ 305 Labor Economics and Labor Relations** 3 Credits
  - **I. Ad. 365D Business Law I** 3 Credits
  - **I. Ad 385 Accounting II** 3 Credits
  - **Additional Institution Management** 3 Credits

### Biological Sciences

- **Bact 304 General Bacteriology** 5 Credits
- **Zool 155 Elementary Human Physiology and Anatomy** 5 Credits

### Physical Sciences and Mathematics

- **Chem 101, 102 General Chemistry** 8 Credits
- **Chem 231 Elementary Organic Chemistry** 4.5 Credits
- **Select from**
  - Biochemistry, chemistry, geology, mathematics, physics, statistics 2.3 Credits

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<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
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<tbody>
<tr>
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<td>Design I</td>
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<td>I M 287</td>
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<td>I M 380</td>
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<td>Study Tour</td>
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<tr>
<td>I M 404</td>
<td>Seminar</td>
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<tr>
<td>I M 484</td>
<td>Purchasing</td>
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<tr>
<td>I M 485</td>
<td>Equipment</td>
<td>4</td>
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<tr>
<td>I Mgt 486</td>
<td>Institution Management Experience</td>
<td>3-5</td>
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<tr>
<td>I M 487</td>
<td>Organization and Management</td>
<td>3</td>
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<td>I M 488</td>
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<tr>
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<tr>
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<tr>
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<tr>
<td>Chem 101, 102</td>
<td>General Chemistry</td>
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<tr>
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<td>Elementary Organic Chemistry</td>
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- Econ 241, 242 Principles of Economics 6 Credits
- Pol S 215 American Government 3 Credits
- Psych 101 General Psychology I 3 Credits
- Soc 134 Introduction to Sociology 3 Credits

Humanities
- Select from history, philosophy, literature, foreign language, music 15 Credits

Written and Spoken English
- Engl 104, 105 Principles of Composition 8 Credits
- Sp 211 Fundamentals of Speech 3 Credits

- I Ad 384 Accounting I 4 Credits
- Lib 101 Library Instruction 6 Credits
- Physical Education 3 Credits

**Major in College Food and Housing Administration**

In addition to the curriculum requirements, the following courses are to be completed:

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<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>I M 489 House Administration</td>
<td>3</td>
</tr>
</tbody>
</table>

Education or Social Science
- Select from
  - Educ 204 Foundations of American Education 3 Credits
  - Educ 305A Methods of Teaching 3 Credits
  - Psych 230 Developmental Psychology 3 Credits
  - Psych 333 Educational Psychology 3 Credits
  - Soc 364 Group Dynamics 3 Credits
  - Soc 380 Social Relations in Industry 3 Credits
  - Soc 450 Human Ecology 3 Credits

Electives 27 29 Credits

Students who wish to emphasize the housing aspect of college food and housing administration should select Concentration B in curriculum and add I Mgt 486C and D 3 credits

**Major in Restaurant Management**

In addition to the curriculum requirements, 39-41 credits are to be planned in consultation with academic adviser.

**Major in School Food Service**

In addition to the curriculum requirements, the following courses are to be completed:

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Educ 204 Foundations of American Education</td>
<td>3</td>
</tr>
<tr>
<td>F &amp; N 410 Nutrition During Human Growth and Development</td>
<td>3</td>
</tr>
<tr>
<td>Electives</td>
<td>35 37</td>
</tr>
</tbody>
</table>
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, 198.

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.

Physical Education

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>P E W 118</td>
<td>American Country Dance</td>
<td>1</td>
</tr>
<tr>
<td>P E W 165</td>
<td>Fundamentals of Modern Dance</td>
<td>1</td>
</tr>
<tr>
<td>P E W 190</td>
<td>Introduction to Physical Education</td>
<td>3</td>
</tr>
<tr>
<td>P E W 251</td>
<td>Fundamentals of Physical Education Activities</td>
<td>1</td>
</tr>
<tr>
<td>P E W 275</td>
<td>Program Development in Physical Education</td>
<td>3</td>
</tr>
<tr>
<td>P E W 370</td>
<td>Principles of Motor Performance</td>
<td>3</td>
</tr>
<tr>
<td>P E W 399</td>
<td>Professional Relations</td>
<td>R</td>
</tr>
<tr>
<td>P E W 452</td>
<td>Evaluation in Physical Education</td>
<td>4</td>
</tr>
<tr>
<td>P E W 480</td>
<td>Scientific Bases of Physical Education</td>
<td>4</td>
</tr>
</tbody>
</table>

Health Education

- F & N 107 Nutrition and the Family's Food 4 Credits
- Hyg 104A and B Health Education 4 Credits
- Hyg 304 School Health Problems 3 Credits

Professional Education

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Educ 204</td>
<td>Foundations of American Education</td>
<td>3</td>
</tr>
<tr>
<td>Educ 305</td>
<td>Methods of Teaching</td>
<td>4</td>
</tr>
<tr>
<td>Educ 426</td>
<td>Principles of Secondary Education</td>
<td>3</td>
</tr>
<tr>
<td>P E W 269</td>
<td>Physical Education for the Elementary School Child</td>
<td>2</td>
</tr>
<tr>
<td>P E W 376</td>
<td>Methods of Teaching Gymnastics and Modern Dance</td>
<td>2</td>
</tr>
<tr>
<td>P E W 385</td>
<td>Techniques and Methods of Social, Folk and Square Dance</td>
<td>2</td>
</tr>
<tr>
<td>Psych 230</td>
<td>Developmental Psychology</td>
<td>3</td>
</tr>
<tr>
<td>Psych 333</td>
<td>Educational Psychology</td>
<td>3</td>
</tr>
<tr>
<td>P E W 417</td>
<td>Supervised teaching in Physical Education in Secondary Schools</td>
<td>9</td>
</tr>
</tbody>
</table>

Biological Sciences

- Zool 155 Elementary Physiology and Anatomy 5 Credits
- Zool 359 Kinesiology 5 Credits

Physical Sciences

- Phys 106 Elementary Physics 4 Credits

Total credits: 3134
## Social Sciences
- Econ 241 Principles of Economics: 3 Credits
- Pol S 215 American Government: 3 Credits
- Psych 101 General Psychology I: 3 Credits
- Soc 134 Introduction to Sociology: 3 Credits

## Humanities
- A A 384 Survey of Art: 3 Credits
- Engl 201 Introduction to Literature: 3 Credits
- Music 354 Music Appreciation: 2 Credits
- History: 6 Credits

## Written and Spoken English
- Engl 104, 105 Language in Composition and Reading: 8 Credits
- Sp 211 Fundamentals of Speech: 3 Credits

### Major in Physical Education for Women

In addition to the curriculum requirements, the following courses are to be completed to meet the requirements for secondary certification:

#### Physical Education for Women
- P E W 150, 151, 152, 250, 252 Fundamentals of Physical Education Activities: 5 Credits
- P E W Swimming Elective: 1 Credit
- P E W 270, 271 Officiating: 4 Credits
- P E W 375 Methods of Teaching Team Sports: 2 Credits
- P E W 377 Methods of Teaching Individual Sports: 2 Credits
- P E W 420 Administration of Physical Education: 3 Credits
- P E W 440 History and Philosophy of Physical Education: 3 Credits

#### Biological Sciences
- Biol 101 Principles of Biology: 3 Credits
- Biol 103 Environmental Biology: 3 Credits

#### Physical Sciences
- Chem 101, 102 or 101A, 102A General Chemistry: 8 Credits

#### Social Sciences

#### Communicative Arts

#### Concentrations

#### Electives

### Major in Physical Education - Dance Option

In addition to the curriculum requirements, the following courses are to be completed:

#### A A 103 Design I

#### General Education
- Physical Science or Mathematics: 5-18 Credits
- Biological Sciences: 0-11 Credits
- Social Sciences: 0-9 Credits
- Humanities: 0-7 Credits
- Communicative Arts: 3-9 Credits
<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Physical Education for Women</strong></td>
<td></td>
</tr>
<tr>
<td>P E W 117 Folk Dance</td>
<td>1</td>
</tr>
<tr>
<td>P E W 210, 211, 212, 213 Composition, Concert Dance, Techniques and</td>
<td>4</td>
</tr>
<tr>
<td>Advanced Modern Dance (1 cr each)</td>
<td></td>
</tr>
<tr>
<td>P E W 310, 311 Dance Production I and II</td>
<td>3</td>
</tr>
<tr>
<td>P E W 313 Practicum in Modern Dance</td>
<td>1</td>
</tr>
<tr>
<td>P E W 380 History and Philosophy of Dance</td>
<td>3</td>
</tr>
<tr>
<td>P E W 386 Methods of Teaching Modern Dance</td>
<td>3</td>
</tr>
<tr>
<td><strong>Select from</strong></td>
<td></td>
</tr>
<tr>
<td>P E W 150, 152 Fundamentals of Physical Education Activities</td>
<td>2</td>
</tr>
<tr>
<td>P E W 377 Methods of Teaching Individual Sports</td>
<td>2</td>
</tr>
<tr>
<td>or</td>
<td></td>
</tr>
<tr>
<td>P E W 151, 250 Fundamentals of Physical Education Activities</td>
<td>2</td>
</tr>
<tr>
<td>P E W 375 Methods of Teaching Team Sports</td>
<td>2</td>
</tr>
<tr>
<td>or</td>
<td></td>
</tr>
<tr>
<td>P E W Electives in Swimming</td>
<td>2</td>
</tr>
<tr>
<td>P E W 379 Methods of Teaching Aquatics</td>
<td>2</td>
</tr>
<tr>
<td><strong>Electives</strong></td>
<td></td>
</tr>
<tr>
<td>Concentration**</td>
<td></td>
</tr>
<tr>
<td><strong>Certification to Teach Physical Education in Elementary Schools</strong></td>
<td></td>
</tr>
<tr>
<td>In addition to the requirements of the major program leading to</td>
<td></td>
</tr>
<tr>
<td>secondary school certification, students desiring to receive</td>
<td></td>
</tr>
<tr>
<td>kindergarten through twelfth grade certification in physical</td>
<td></td>
</tr>
<tr>
<td>education must complete the following courses:</td>
<td></td>
</tr>
<tr>
<td>C D 337 Development and Guidance in Later Childhood</td>
<td>3</td>
</tr>
<tr>
<td>Ed 344 Principles of Teaching in the Elementary Schools</td>
<td>2</td>
</tr>
<tr>
<td>P E W 418 Supervised Teaching of Physical Education in the Schools</td>
<td>2</td>
</tr>
<tr>
<td>(May satisfy 2.5 credits of requirement for supervised teaching of</td>
<td>5</td>
</tr>
<tr>
<td>physical education. 417)</td>
<td></td>
</tr>
<tr>
<td>P E W 472 Creative Rhythmic Activities for Elementary School Children</td>
<td>2</td>
</tr>
<tr>
<td>P E W 473 Games and Activities for Elementary School Children</td>
<td>2</td>
</tr>
<tr>
<td>Music 365 Music in the Elementary Schools</td>
<td>3</td>
</tr>
<tr>
<td>Select from child development, music, physical education</td>
<td>3</td>
</tr>
</tbody>
</table>

1 Students who do not elect to complete the elementary physical education certification program or who do not elect to complete a half-time teaching field in an approved area must take a concentration of 15 credits, above those required in the major program, in any selected area within the University. For students in a Teacher Education Curriculum the following courses would provide a 30 credit program in Dance Education P E W 117, 118, 165, 210, 211, 212, 213, 310, 311, 313, 380, 385, 386, Zooll 155, Music 354, A A 384.
Curriculum in Textiles and Clothing

Leading to the degree Bachelor of Science. Total credits required, 198.

Two majors are offered in the Textiles and Clothing Department: 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:

<table>
<thead>
<tr>
<th>Written and Spoken English</th>
<th>11 Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engl 104, 105 Language in Composition and Reading</td>
<td>8 Credits</td>
</tr>
<tr>
<td>Sp 211 Fundamentals of Speech</td>
<td>3 Credits</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Social Sciences</th>
<th>18 Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anthro 218 Introduction to Cultural Anthropology</td>
<td>3 Credits</td>
</tr>
<tr>
<td>Econ 241, 242 Principles of Economics</td>
<td>6 Credits</td>
</tr>
<tr>
<td>Pol S 215 American Government</td>
<td>3 Credits</td>
</tr>
<tr>
<td>Psych 101 General Psychology</td>
<td>3 Credits</td>
</tr>
<tr>
<td>Soc 134 Introduction to Sociology</td>
<td>3 Credits</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Physical Sciences and Mathematics</th>
<th>15 Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chem 101, 102 General Chemistry</td>
<td>8 Credits</td>
</tr>
<tr>
<td>Mathematics</td>
<td>3 Credits</td>
</tr>
<tr>
<td>Organic Chemistry</td>
<td>4 Credits</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Biological Sciences</th>
<th>8 Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zool 155 Elementary Human Physiology and Anatomy</td>
<td>5 Credits</td>
</tr>
<tr>
<td>Additional credits</td>
<td>3 Credits</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Humanities</th>
<th>15 Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hist 201, 202 Study of Western Civilization</td>
<td>8 Credits</td>
</tr>
<tr>
<td>Additional credits</td>
<td>7 Credits</td>
</tr>
</tbody>
</table>

| Lib 101 | R |

<table>
<thead>
<tr>
<th>Home Economics</th>
<th>16 Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>A A 103 Design I</td>
<td>4 Credits</td>
</tr>
<tr>
<td>F E 270 The Individual and His Family</td>
<td>4 Credits</td>
</tr>
<tr>
<td>F E 375 Management in the Family</td>
<td>4 Credits</td>
</tr>
<tr>
<td>F &amp; N 107 Nutrition and the Family’s Food</td>
<td>4 Credits</td>
</tr>
<tr>
<td>H Ec 400 Professional Relations</td>
<td>R</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Physical Education</th>
<th>6 Credits</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Textiles and Clothing</th>
<th>13 14 Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>T &amp; C 104 Textiles</td>
<td>4 Credits</td>
</tr>
<tr>
<td>T &amp; C 123 or 125 Pattern Making and Clothing Construction</td>
<td>4 5 Credits</td>
</tr>
<tr>
<td>T &amp; C 210 Sophomore Seminar</td>
<td>1 Credit</td>
</tr>
<tr>
<td>T &amp; C 245 Clothing Selection</td>
<td>3 Credits</td>
</tr>
<tr>
<td>T &amp; C 401 Senior Study Tour</td>
<td>R</td>
</tr>
<tr>
<td>T &amp; C 410 Textiles and Clothing Department Seminar</td>
<td>1 Credit</td>
</tr>
</tbody>
</table>

Major in Textiles and Clothing

This major may lead to careers in merchandising, fashion promotion, commercial or custom designing, or educational positions with industry.

In addition to the core curriculum requirements, the following courses are to be completed.

| A A 150 Drawing I | 3 Credits |
| A A 213 Fashion Illustration I | 3 Credits |
| Engl 404 Business Correspondence | 2 Credits |
| I Ad 365 Business Law I | 3 Credits |
| I Ad 384 Accounting I | 4 Credits |
| I Ad 340 Industrial Marketing I (3 cr) | or |
Econ 466 Retailing (3 cr) 3 Credits
T & C 225 Draping and Clothing Construction 4 Credits
T & C 345 Costume Design and Selection 3 Credits
T & C 225 Publicity and Public Relations (3 cr) 3 Credits
or
T & C 325 Advertising (3 cr) 3 Credits
or
Psych 250 Consumer Psychology (3 cr) 3 Credits

Design Option
A A 335 Textile Design I (3 cr) 3 Credits
or
T & C 304 Intermediate Textiles (3 cr) 3 Credits
A A 384 Survey of Art 3 Credits
A A 485 Medieval, Renaissance and Oriental Art (3 cr) 3 Credits
or
A A 486 Modern Art (3 cr) 3 Credits
T & C 326 Children's Clothing (3 cr) 3 Credits
or
T & C 429 Custom Tailoring (4 cr) 3.4 Credits
T & C 414 Historic Textiles 3 Credits
T & C 454 History of Costume 3 Credits
T & C 465 Introduction to Sociological and Psychological Aspects of Clothing and Textiles 3 Credits
Electives 45-47 Credits

Merchandising Option
A A 261 Interior House Design 3 Credits
Econ 305 Labor Economics and Labor Relations (3 cr) 3 Credits
or
Soc 380 Social Relations in Industry (3 cr) 3 Credits
T & C 304 Intermediate Textiles 3 Credits
T & C 365 Textiles and Clothing Merchandising 3 Credits
T & C 404 Advanced Textiles 3 Credits
T & C 414 Historic Textiles (3 cr) 3 Credits
or
T & C 454 History of Costume (3 cr) 3 Credits
or
A A 384 Survey of Art (3 cr) 3 Credits
T & C 464 Family Clothing Consumption 3 Credits
Electives 6 Credits (total) 3 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:

Math 101, 102 Algebra and Trigonometry 10 Credits
Math 110, 111 Analytic Geometry and Calculus I, II 10 Credits
(Three credits of which satisfy mathematics requirement)
Engl 414A Writing of Reports and Technical Papers 3 Credits
Foreign Language 12 Credits
(Seven credits of which satisfy humanities option)
Stat 201 Principles of Statistics 5 Credits

Physical Science Option Textiles
T & C 304 Intermediate Textiles 3 Credits
T & C 404 Advanced Textiles 3 Credits
T & C 414 Historic Textiles 3 Credits
<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>FE 254 Equipment in the Home</td>
<td>3 Credits</td>
</tr>
<tr>
<td>FE 408 Equipment for Care of Modern Fabrics</td>
<td>4 Credits</td>
</tr>
<tr>
<td>Bact 304 General Bacteriology</td>
<td>4 Credits</td>
</tr>
<tr>
<td>(Three credits of which satisfy biological sciences option)</td>
<td></td>
</tr>
<tr>
<td>Chem 103 Systematic Inorganic Chemistry</td>
<td>4 Credits</td>
</tr>
<tr>
<td>Chem 211 Quantitative Analysis</td>
<td>5 Credits</td>
</tr>
<tr>
<td>Chem 334, 335 Organic Chemistry</td>
<td>6 Credits</td>
</tr>
<tr>
<td>(Four credits of which satisfy organic chemistry requirement)</td>
<td></td>
</tr>
<tr>
<td>Phys 111, 112 General Physics</td>
<td>8 Credits</td>
</tr>
<tr>
<td>Electives</td>
<td>29 Credits</td>
</tr>
<tr>
<td><strong>Social Science Option Clothing</strong></td>
<td></td>
</tr>
<tr>
<td>T &amp; C 465 Introduction to Sociological and Psychological Aspects of Clothing and Textiles</td>
<td>3 Credits</td>
</tr>
<tr>
<td>T &amp; C 454 History of Costume</td>
<td>3 Credits</td>
</tr>
<tr>
<td>T &amp; C 464 Family Clothing Consumption</td>
<td>3 Credits</td>
</tr>
<tr>
<td>A A 384 Survey of Art (3 cr)</td>
<td>3 Credits</td>
</tr>
<tr>
<td>or T &amp; C 414 Historic Textiles (3 cr)</td>
<td>5 Credits</td>
</tr>
<tr>
<td>Econ 307, 308 Prices and Resource Allocation</td>
<td>6 Credits</td>
</tr>
<tr>
<td>Soc 485 Sociology of the Family (3 cr)</td>
<td>3 Credits</td>
</tr>
<tr>
<td>or F E 488 Family Finance (3 cr)</td>
<td>3 Credits</td>
</tr>
<tr>
<td>Soc 202 Sociological Inquiry</td>
<td>3 Credits</td>
</tr>
<tr>
<td>Soc 301 Principles of Sociology (3 cr)</td>
<td>3 Credits</td>
</tr>
<tr>
<td>or Soc 305 Social Interaction (3 cr)</td>
<td>3 Credits</td>
</tr>
<tr>
<td>or Soc 330 Social Stratification (3 cr)</td>
<td>3 Credits</td>
</tr>
<tr>
<td>Psych 201 Learning and Motivation</td>
<td>3 Credits</td>
</tr>
<tr>
<td>Psych 380 Social Psychology (3 cr)</td>
<td>3 Credits</td>
</tr>
<tr>
<td>or Psych 230 Developmental Psychology (3 cr)</td>
<td>3 Credits</td>
</tr>
<tr>
<td>or Psych 440 Psychological Measurement (3 cr)</td>
<td>3 Credits</td>
</tr>
<tr>
<td>Electives</td>
<td>32 Credits</td>
</tr>
<tr>
<td><strong>Total Credits</strong></td>
<td>33 Credits</td>
</tr>
</tbody>
</table>
College of Sciences and Humanities

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 music. 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 degree Bachelor of Science the student must earn a total of at least 192 academic credits which shall include:

1. At least 99 credits in the basic groups specified below
2. At least 30 additional credits in a major subject, as specified below
3. At least 21 additional credits in one minor subject, or a total of at least 27 additional credits in two minor subjects, as specified below
4. At least three credits in basic physical education courses
5. A course in library science (normally Lib 205)
6. Sufficient additional credits in elective courses to bring the total to at least 192 (not more than six credits in basic physical education courses, nor more than six credits earned in 100-level music performance groups may be included among the required 192 credits)

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. Not later than four quarters before graduation he must submit a formal degree program showing all courses which he has taken or proposes to take in fulfillment of the degree requirements. This must be approved by the student's major department and by the dean of the College of Sciences and Humanities.

The Basic Group 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. (Wherever a semicolon appears in this list, it means "and/or"). The number of credits in each group counted toward fulfillment of this requirement must lie within the range indicated.

1. Written and Spoken English
   Engl 104 and 105 (or 131 and 132), and Sp 211 are required of all students. Additional courses may be chosen from Engl 204, 205, 304A, 304B, 306A, 306B, 315, 414
   14 - 21 credits

2. Mathematical Sciences
   Mathematics, statistics, computer science
   9 - 21 credits

3. Physical Sciences
   Physics, chemistry, geology, metallurgy, meteorology, biochemistry, biophysics
   9 - 21 credits

4. Biological Sciences
   Biology, botany, zoology, bacteriology, genetics
   9 - 21 credits
5 Social Sciences
   Psychology, sociology, anthropology, economics, political science, geography, industrial administration
   (except courses in accounting) Pol. S. 215 is required of all students
   9 21 credits

6 Humanities
   History, literature, philosophy
   9 21 credits

7 Foreign Languages
   At least 12 credits must be in one language
   12 21 credits

In addition to credits earned in the seven groups specified above, the student may also include among the required 99 credits as many as nine credits in approved music and art courses. (Courses in music fundamentals, music listening and appreciation, and music history are acceptable; courses in applied music, music education, and music performance are not. The only acceptable art courses are A. A. 384, Arch. 124, and Des. C. 125, 126, 127.) As many as nine credits earned in D. St. 104, 105 and 106 may also be counted among the 99 credits required.

The Major Requirement

The student must earn at least 30 credits in his major field in addition to any credits in that field that are counted toward fulfillment of the basic group requirement. The major department must approve the course program and may set higher requirements than the minimum demanded by the college if it is deemed appropriate in that area of study. The major may be chosen from the following list. (See Index for page references to individual departmental statements.)

- Anthropology
- Bacteriology
- Biochemistry
- Biology
- Biophysics
- Botany
- Chemistry
- Computer Science
- 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
- Science Journalism
- Sociology
- Spanish
- Speech
- Statistics
- Zoology

Students who wish to do so may elect to complete a second major instead of meeting the minor requirement described below. Both major departments must then approve the degree program.

A special program in international relations is available as a second major to students whose first major is in anthropology, economics, a foreign language, history, journalism, political science or sociology. For a complete description of this program see Index, International Service Programs.

For information concerning preparation for the study of law, medicine, and other professional disciplines, see Index, Pre-professional Programs.

The Minor Requirement

The student 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 six credits in courses numbered 300 or above. Credits counted toward fulfillment of the basic group require-
ment can not 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 genetics, telecommunicative arts, Air Force aerospace studies, and 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.

The Distributed Studies Program

The distributed studies program offers the possibility of pursuing somewhat broader and less intensive 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 stated above 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 his own schedule with the guidance of his faculty adviser, and the schedule may vary widely, depending on the student’s major field and his own special interests and goals.

There are only a few general rules that can be given for planning. During his first year the student should complete Engl. 104 and 105, Lib. 205, and three credits in basic physical education; he should also make a substantial beginning on the basic group requirements. By the end of his second year he should have completed a large part of the basic group requirements and should have laid the foundation for advanced work in his major and minor. The third and fourth years are usually devoted to a large extent to the completion of the major and minor requirements.

Because the student’s entire program depends critically on his choice of major field, that choice should be made as soon as possible, and in no case 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.
## 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.

### FALL QUARTER

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quantitative Analysis</td>
<td>5</td>
</tr>
<tr>
<td>Analytic Geometry and Calculus I</td>
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<tr>
<td>Language in Composition and Reading</td>
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</tr>
<tr>
<td>English</td>
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<td>Physical Education</td>
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<td>Elective</td>
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### WINTER QUARTER

<table>
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<tr>
<td>Analytic Geometry and Calculus II</td>
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</tr>
<tr>
<td>Language in Composition and Reading</td>
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<td>English</td>
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### SPRING QUARTER

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
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</thead>
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<tr>
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<tr>
<td>Analytic Geometry and Calculus III</td>
<td>5</td>
</tr>
<tr>
<td>Fundamentals of Speech</td>
<td>3</td>
</tr>
<tr>
<td>Library Science</td>
<td>1</td>
</tr>
<tr>
<td>Physical Education</td>
<td>1</td>
</tr>
<tr>
<td>Elective</td>
<td>3</td>
</tr>
</tbody>
</table>

### Freshman Year

- **Organic Chemistry**
  - Chem 330, 331: 5 credits
- **Introduction to Classical Physics**
  - Phys 221: 5 credits
- **American Government**
  - Pol S 215: 3 credits
- **Elective**
  - 3 credits

### Sophomore Year

- **Organic Chemistry**
  - Chem 330, 332: 5 credits
- **Introduction to Classical Physics**
  - Phys 222: 5 credits
- **Electives**
  - 6 credits

### Junior Year

- **Physical Chemistry**
  - Chem 326, 327B: 6 credits
- **Advanced Inorganic Chemistry**
  - Chem 301: 3 credits
- **Foreign Language**
  - F L 122 or 132: 4 credits
- **Elective**
  - 3 credits

### Senior Year

- **Approved Engineering Elective**
  - 3 credits
- **Approved Engineering Elective**
  - Chemical Process Industries: 3 credits
  - Elective: 9 credits

### Credits

- **Freshman Year**: 18 credits
- **Sophomore Year**: 16 credits
- **Junior Year**: 16 credits
- **Senior Year**: 15 credits

Of the 69 elective credits, at least 21 must be in advanced chemistry, biochemistry, biophysics, physics, mathematics, computer science, biological science, or chemical engineering. Of these 21 credits, six must be advanced chemistry or advanced biochemistry and should be in lecture courses. Of the remaining 48 credits, nine must be in biological science, nine must be in history, literature, philosophy, or advanced English composition, and at least six must be in economics, industrial administration, sociology, psychology or political science (other than Pol S 215). Twenty-four credits are not specified.
Curriculum in Physical Education for Men

This curriculum leads to the degree Bachelor of Science and is an alternative to the Curriculum in Sciences and Humanities with a major in physical education for men.

One year of high school algebra is required for admission into this curriculum.

One hundred ninety-two credits, including six credits from the basic instruction program in physical education and one credit of library instruction, must be earned in accordance with the following requirements for graduation.

**FALL QUARTER**

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Language in Composition and Reading</td>
<td>4</td>
</tr>
<tr>
<td>Engl 104</td>
<td></td>
</tr>
<tr>
<td>Introduction to Physical Education</td>
<td>3</td>
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<tr>
<td>P E M 200</td>
<td></td>
</tr>
<tr>
<td>General Psychology</td>
<td>3</td>
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<tr>
<td>Psych 101</td>
<td></td>
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<tr>
<td>Health Education</td>
<td>3</td>
</tr>
<tr>
<td>Hyg. 104</td>
<td></td>
</tr>
<tr>
<td>Freshman Physical Education for Men</td>
<td></td>
</tr>
<tr>
<td>P E.M. 101 or 190</td>
<td>1</td>
</tr>
</tbody>
</table>

In addition to the courses listed above the student must complete three to five credits in physical or biological science each quarter of the freshman year, including Zool 155. This program can be modified to permit qualified students to study mathematics during the freshman year.

The student will, with the aid of his adviser, submit a degree program for the approval of his department head and the dean of the College of Sciences and Humanities not later than the spring quarter of his sophomore year.

Such a degree program shall include

1. A minimum of 33 credits distributed in the areas of English, literature, speech, history, sociology, and economics
2. A minimum of 48 credits in physical education, including P E M 497, but not more than 60 credits may apply for the degree
3. A minimum of 16 credits in the area of animal biology and hygiene
4. The requirements of one of the following vocational areas

- **Teaching and Coaching**
  a. The core courses in teacher education, and Ed. 305A and Ed. 426.
     See *Index, College of Education*.
  b. The requirements for teacher certification in either one area of concentration (45 credits) or two restricted areas (30 credits each) in addition to physical education. See *Index, College of Education*. These may be elected from art, biology, chemistry, earth science, English, foreign languages, general agriculture, general science, history, industrial education, journalism, mathematics, physics, political science, safety education, social studies and speech.

- **Journalism and Broadcasting**
  b. A minimum of 40 credits in journalism and telecommunicative arts.

- **Supervised Recreation**
  a. Of the credits in physical education, 22 credits shall be in the areas of supervised recreation and four in dance courses offered by the Department of Physical Education for Women.
  b. Nine credits in landscape architecture and urban planning.
  c. Ten credits in industrial administration.
  d. A minimum of 18 credits in sociology.
  e. A minimum of 15 credits in one area of specialization to be selected from speech and drama, art, music, fisheries and wildlife biology, forestry, urban planning, landscape architecture, or industrial administration.
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, botany, nutrition, and other related sciences is provided by other colleges of the University. In addition to the strictly educational departments the Veterinary Medical Research Institute and the Veterinary Medical Diagnostic Laboratory give the student opportunity to observe those 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 pre-professional college work, with a creditable academic average, is required for admission to the professional curriculum in Veterinary Medicine. Students in Veterinary Medicine 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 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 covers not only the health and well-being of nearly every form of domestic or captive animal. It has joined with the profession of human medicine in protecting the health and physical well-being of all species.

With the increased responsibilities of the profession have come increased opportunities for those who practice it.

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. Many veterinarians enter 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, small animals, horses, swine, or cattle. Others prefer to specialize along disciplinary lines such as obstetrics or surgery. Many now maintain private hospitals adequately equipped for the diagnosis and treatment of diseases of household pets, and devote their practice entirely to this field. Associations of a number of specialists in a group practice are beginning to appear.

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 both technical laboratory and field work.

Public Health Service

Federal, state and local governments employ veterinarians as a part 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. When he enters 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 private interests now employ veterinarians. Among these are artificial breeding organizations, zoological societies, livestock ranches, humane societies and the fur industries.

VETERINARY MEDICAL SOCIETIES

All veterinary students are members of the Iowa State Student Chapter of the American Veterinary Medical Association. The bi-weekly 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 University 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. The college credits must include:

<table>
<thead>
<tr>
<th>Subject</th>
<th>Credits</th>
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<tbody>
<tr>
<td>English</td>
<td>11 qr crs (8 sem. crs.)</td>
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<tr>
<td>Chemistry</td>
<td>24 qr crs (16 sem. crs.)</td>
</tr>
<tr>
<td>Mathematics</td>
<td>10 qr crs (6 sem. crs.)</td>
</tr>
<tr>
<td>Physics</td>
<td>12 qr crs (8 sem. crs.)</td>
</tr>
<tr>
<td>Biological Sciences</td>
<td>18 qr crs (12 sem. crs.)</td>
</tr>
<tr>
<td>American Government</td>
<td>3 qr crs (2 sem. crs.)</td>
</tr>
</tbody>
</table>

Pre-professional students at Iowa State University enroll in either the College of Agriculture or the College of Sciences and Humanities. A pre-veterinary student at Iowa State University may elect a three year pre-veterinary 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 pre-veterinary 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 pre-veterinary 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. Pre-professional 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 lower 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 pre-admission conference with members of the veterinary faculty or other persons designated by the dean is required. High school records, scholastic performance in pre-professional course studies, 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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<tr>
<td>Microscopic Anatomy</td>
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<td>V. An. 301</td>
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<td>V. An. 303</td>
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<tr>
<td>V. An. 311</td>
<td>V. An. 312</td>
<td>V. An. 313</td>
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<td>Physiological Chemistry</td>
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<td>Comparative Mammalian Physiology</td>
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<tr>
<td>B. &amp; B. 304, 314</td>
<td>B &amp; B 305, 315</td>
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| **Second Year** |                |                |
| Pharmacology and Therapeutic Principles | Pharmacology | Disturbances of Reproduction |
| V. Phy 367 | V. Phy 368 | V.C.S. 391 |
| General Bacteriology & Immunology | Pathogenic Bacteriology | General Surgery |
| V. Micr. 381 | V Micr. 382 | V.C.S. 397 |
| Animal Nutrition I | Animal Nutrition II | Virology & Epidemiology |
| An S. 418 | An S 419 | V. Micr. 383 |
| General Pathology | Parasitology | General Medicine |
| V. Pth. 371 | V. Pth. 376 | V.C.S. 394 |
| | | Parasitology |
| | | V. Pth. 377 |
| **19** | **19** | **21** |

| **Third Year** |                |                |
| Special Surgery II | Special Surgery II | Special Surgery III |
| V.C.S. 441 | V.C.S 442 | V.C.S 443 |
| Applied Anatomy | Clinical Medicine II | Radiology |
| V. An. 406 | V.C.S. 445 | V.C.S. 440 |
| Clinical Medicine I | Infectious Diseases | Clinical Medicine III |
| V. C S 444 | V Micr. 432 | V.C.S 446 |
| Infectious Diseases | Special Pathology | Infectious Diseases |
| V. Micr. 431 | V Pth. 422 | V. Micr. 433 |
| Special Pathology | Veterinary Clinical Sciences | Special Pathology |
| V. Pth 421 | V C S 448 | V Pth 423 |
| Veterinary Clinical Sciences | | Veterinary Clinical Sciences |
| V C S 447 | | V C S 449 |
| | | Veterinary Toxicology and Poisonous Plants |
| | | V Pth 456 |
| **21** | **21** | **21** |

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1Cross listed in both Veterinary Anatomy and Veterinary Clinical Science
2Cross listed in both Botany and Veterinary Pathology
First or Second Summer Session

Applied Veterinary Science
V C S 491 6

Fourth Year

<table>
<thead>
<tr>
<th>Applied Veterinary Science</th>
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<tr>
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<tr>
<td>V C S 493</td>
<td>V C S 496</td>
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<tr>
<td>Public Health I</td>
<td>Public Health II</td>
<td>Professional Orientation and Jurisprudence</td>
</tr>
<tr>
<td>V Micr 484</td>
<td>V Micr 485</td>
<td>V C S 498</td>
</tr>
</tbody>
</table>

18 18 18

1Taught by all veterinary departments

READMISSION

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.
Graduate College

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 the earlier 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, Dean of Admissions and Records, heads of departments offering graduate work, and members of the faculty who are elected to membership in recognition of their accomplishments in their respective disciplines.

The Graduate College administers advanced study and degree programs in all fields 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 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 Engineering, Master of Forestry, Master of Landscape Architecture and Master of Education are offered. These degrees permit greater program latitude than is permitted for the degree Master of Science.

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 $62 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, 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 post doctoral study through the extensive research programs of the University. Inquiries should be directed to the appropriate Institute or 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 five 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 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, 104 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.

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 chairman 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 full 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 Each new graduate student entering Iowa State University 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. Any student unable to have his physical examination before coming to the University may make arrangements to have the examination by the Student Health Service staff for the regular fee.

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, are required to take a qualifying examination in English at the time scheduled during the first quarter or summer term of residence.

Those who fail the examination must report to the Writing Clinic for assistance. A student may expect to be dropped from the Graduate College if the examination in English is not passed by the end of the third quarter of registration.
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 five 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 one credit for each week that the student is in residence. The fee is $18 per credit for residents and $32 per credit for non-residents.

"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 adviser. 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 six 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, 7 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

A student becomes eligible for candidacy after completing one quarter's work with a "B" average. General requirements for the degree are as follows:

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 residence. 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. Designation of a minor field is advisable to avoid too-narrow specialization. If the minor is taken in the major department, it must be a distinct subdivision of that 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.

Except where otherwise noted in the departmental description, a satisfactory reading knowledge of one language is required. 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 before 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. is granted except where specific provisions are made for a non-thesis M.S. degree. Joint authorship is not permitted. Copies of the completed thesis must be in the hands of the examining committee and the Librarian for approval two weeks prior to the date fixed for the final examination. After the final examination two complete and approved copies of the thesis shall be deposited with the Director of the 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 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.** Upon completion of other requirements, the candidate will request from the Office of the Graduate Dean a graduation approval slip. This must be filled out completely and returned to the Registrar by the date indicated thereon.

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 - non-thesis**

In some fields where research specialization does not best meet the professional needs of the student, a non-thesis Master of Science degree program may be undertaken. This will require satisfactory completion of 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 Arts**

This degree is available in certain fields where it is the more appropriate degree. A minimum of 45 quarter hours of acceptable credits is required as is the satisfactory completion of a comprehensive examination. Detailed descriptions of the programs available will be found in the departmental descriptions of this catalog.

**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 Department of Education. 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 professional-oriented programs on campus. Requirements for the Master of Engineering are as follows:

General requirements are the same as those for the degree Master of Science with the following exceptions: (1) No foreign language is required. (2) Upon recommendation of the student's committee, the thesis requirement may be waived. Choice of this option requires the completion of an additional seven 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 non-thesis 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 Committee. Upon admission of the graduate student to work looking toward the degree Doctor of Philosophy, 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 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 chairman of a doctoral committee.

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 one-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 insti-
tution 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) disciplines 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.

Except where otherwise noted in the departmental description, a satisfactory reading knowledge of two languages or a comprehensive knowledge of one language is required. 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 in 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 before 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 Director of the Library 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 Director of the Library.

At the same time the dissertation is deposited, two typewritten copies of an abstract which meets the requirements as set forth in the Thesis Manual must also be filed with the Director of the Library. A charge of $50 will be made to cover library costs, microfilming of the dissertation and publication of a 600-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. Upon completion of other requirements, the candidate will request from the Office of the Graduate Dean a graduation approval slip. This must be filled out completely and returned to the Registrar by the date indicated thereon.

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.
Courses and Programs

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.

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. 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.

Prerequisites may be waived by permission of the instructor.

AEROSPACE ENGINEERING

Ernest W. Anderson, Ph.D., Head of Department

Professors: Cheng-Ting Hsu, Ph.D.; Merlin L. Millett, Jr., Ph.D.

Associate Professors: Dale A. Anderson, Ph.D.; James D. Iversen, Ph.D.; Fredrick W. Stuve, M.S.

Assistant Professors: Jerome C. Glaser, Ph.D.; Paul J. Hermann, M.S.; William D. James, M.S.; L. L. Northup, Ph.D.; Bion L. Pierson, Ph.D.; Leverne K. Seversike, Ph.D.

Courses and Programs

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, missile 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 major work for the degree Master of Science 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, for the degree Doctor of Philosophy, with the approval of the graduate student’s committee, a minimum of 15 credits of additional work not related to the major is required. This work may include a foreign language.

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.

Open to graduate students for minor credit only: 309, 321, 331, 343, 344, 352, 353, 411, 413, 415, 421, 423, 431, 432, 433, 441, 442, 443, 452, 453, 455, 456, 461, 462, 463, 470, 480.

COURSES PRIMARILY FOR UNDERGRADUATE STUDENTS

100. TECHNICAL LECTURE. (1-0) Cr. R. S. Orientation in the field of aerospace engineering.

244. AERODYNAMICS I. (2-0) Cr. 2. F. Prerequisite: Math. 111; Phys. 221. History of aeronautics. Introduction to incompressible aerodynamics.

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. 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. (4-0) Cr. 4. F. 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. W. 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.

331. AEROSPACE INSTRUMENTATION. (3-0) Cr. 3. S. Prerequisite: E.E. 442. Instrumentation theory and applications in aerospace engineering.

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.
341. 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.

342. AERODYNAMIC THEORY II.
(3-0) Cr. 3. W.
Prerequisite: 441.
Principles of compressible and incompressible flow. Application to airfoils, wings and solids of revolution.

343. FLIGHT SYSTEMS TESTING.
(1-6) Cr. 3. S.
Prerequisite: 331, 431.
Application of instrumentation to flight systems. Reduction and analysis of experimental data as obtained from aerospace systems. Aircraft, missile, and satellite testing.
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. Alt. W.S. offered 1970.
Prerequisite: 431 or equivalent.

541. 542. 543. ADVANCED AERODYNAMICS.
(M.E. 541, 542, 543) (3-0) Cr. 3 each. Yr.
Prerequisite: 544.
Classical flow theory, compressible fluid theories, shock wave studies, and applications to aerodynamic shapes.

544. ADVANCED AERODYNAMICS.
(3-0) Cr. 3. S.
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. AEROELASTICITY.
(3-0) Cr. 3 each. Alt. W.S. Offered 1970.
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.
(3-0) Cr. 3 each. Alt. W.S. Offered 1971.
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. MAGNETOFIUIDMECHANICS AND PLASMA DYNAMICS.
(M.E. 623, 624) (3-0) Cr. 3 each. Alt. F.W. Offered 1970.
Prerequisite: 541, 542, 543, Math. 322.

628. RADIATION GAS DYNAMICS.
(3-0) Cr. 3. Alt. S. Offered 1971.
Prerequisite: 623.

650. 551. FLIGHT MECHANICS.
(3-0) Cr. 3 each. F.W.
Prerequisite: 344, Math. 322.

552. PERFORMANCE ANALYSIS.
(2-3) Cr. 3. S.
Performance of aircraft, missiles and space vehicles.

553. ENTRY DYNAMICS.
(3-0) Cr. 3. S.
Prerequisite: 551.
Atmospheric entry and entry dynamics of missiles and space vehicles.

556. DESIGN AND ANALYSIS.
(2-6) Cr. 4. S.
Prerequisite: 462 or equivalent, Math. 322. Applications of analysis and theory of design. Applications to design problems of aircraft, missile and space vehicles and their trajectories.

595. SPECIAL TOPICS.
Cr. 1 to 5. F.W.S.
A. Aero and/or Gasdynamics.
B. Propulsion.
C. Stress Analysis.
D. Missile and Space Theory.
E. Flight Systems.
F. Magnetofluidodynamics
G. Hydrospace.
651, 652. MECHANICS OF SPACE VEHICLE TRANSFERS.
(3-0) Cr. 3 each. Alt. W.S. Offered 1971.
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.

670. RESEARCH.

AGRICULTURAL BUSINESS

For description of courses, see Economics.

AGRICULTURAL EDUCATION

Clarence E. Bundy, M.S., Chairman of Department

Professors: John McClelland, Ph.D.; Vilas J. Morford, M.S.
Associate Professor: Thomas A. Hoerner, Ph.D.
Assistant Professors: Harold R. Crawford, M.S.; Alan A. Kahler, Ph.D.; Windol L. Wyatt, M.S.
Instructor: Joseph F. Bendixen, M.S.

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. Persons not preparing for teaching may elect the business option.

Graduate Study

The department offers major work for the degrees Master of Science, Master of Education and Doctor of Philosophy 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.

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 of 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 credits for two languages. Students whose native language is not English may substitute competence in English for one of the languages.

Off-campus courses are offered for professional personnel in the field. Three-week courses are offered during the summer sessions for vocational agriculture and agricultural extension personnel.

695. SPECIAL TOPICS FOR ADVANCED GRADUATE STUDENTS.
Cr. 1 to 5. F.W.S.
A. Aero and/or Gasdynamics.
B. Propulsion.
C. Stress Analysis.
D. Missile and Space Theory.
E. Flight Systems.
F. Magnetofluidodynamics.
G. Hydrospace.
COURSES PRIMARILY FOR UNDERGRADUATE STUDENTS

211A, 211B. OBSERVATION AND SURVEY OF PROGRAM OF EDUCATION IN AGRICULTURE.
(Educ. 211) (0-3) Cr. 1 each. A: S; B: F. S. Prerequisite: Junior classification, quality point average of 2.5 or more for preceding two quarters.

211A Agricultural Education. Visitaton of high school departments of agriculture. Survey of day school, young and adult farmer programs. Field trips. Extension Education. Visitaton of central staff departments, county programs and special day activities, observation and discussion of Extension education programs in agriculture and home economics. Field trips.

211B. Extension Education. Visitaton of central staff departments, county programs and special day activities, observation and discussion of Extension education programs in agriculture and home economics. Field trips.

321. PLANNING AND EVALUATING THE PROGRAM IN VOCATIONAL AGRICULTURE.
(Educ. 321) (2-3) Cr. 3. F.S. Prerequisite: Ag. Ed. 423, 424. Crawford.

Purpose: Organization, methods and evaluation of the program of vocational agriculture. Departments are visited to observe programs and results.

423. METHODS OF TEACHING VOCATIONAL AGRICULTURE IN HIGH SCHOOL.
(Educ. 423) (3-0) Cr. 3. F.W.S. Prerequisite: 321.

Course organization, methods, farming programs, employment training and Future Farmers of America activities. Departments are visited to observe programs and results.

424. YOUNG FARMER AND ADULT EDUCATION IN AGRICULTURE.
(Educ. 424) (3-0) Cr. 3. F.W.S. Prerequisite: 321.

Methods in organizing and teaching classes in vocational agriculture and technical school programs for young and adult farmers. Departments visited to determine best practices.

425. OBSERVATION AND SUPERVISED TEACHING IN AGRICULTURE.
(Educ. 425) Cr. 3 to 12. F.W.S.

Three to nine weeks of full-time observation and supervised teaching in public schools. To be scheduled with "as arranged" courses and special sections.

490A. SPECIAL PROBLEMS IN AGRICULTURAL EDUCATION.
(Educ. 490A) Cr. 1 to 5. F.W.S. 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

520. INSTRUCTIONAL TECHNIQUES AND MATERIALS IN AGRICULTURAL EDUCATION.
(Educ. 520) (3-0) Cr. 3. F.S. Off-campus. Prerequisite: Ag. Ed. 423, 424. Crawford.

Innovations and advanced principles in developing instructional plans and materials. Teaching decision making, programmed learning, demonstration method, field trips, selection of reference materials, development of audio visual materials.

538. POST HIGH SCHOOL EDUCATION IN AGRICULTURE.
(Educ. 538) (3-0) Cr. 3. S. Kahler.

Prerequisite: 424.

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.

540. EDUCATIONAL IMPLICATIONS OF OCCUPATIONAL ADJUSTMENT IN AGRICULTURE.
(Educ. 540) (3-0) Cr. 3. W.S. Prerequisite: 423, 424. Bundy, Kahler.

Analysis of farming and other occupational opportunities in agriculture in individual communities, states and nation. Methods in analyzing individual situations and in program planning.

590A. SPECIAL TOPICS IN AGRICULTURAL EDUCATION.
(Educ. 590A) Cr. 1 to 5. F.W.S. Prerequisite: 15 credits in education. Bundy, Crawford, Hoerner, Kahler.

593A. WORKSHOP IN AGRICULTURAL EDUCATION.
(Educ. 593A) Cr. 1 to 5. F.W.S. Prerequisite: 590A. Bundy, Crawford, Kahler.

COURSES FOR GRADUATE STUDENTS, major or minor

604. THE COMMUNITY SCHOOL PROGRAM OF AGRICULTURAL EDUCATION.
(Educ. 604) (3-0) Cr. 3. SSI. Bundy, Kahler.

Organization of vocational agriculture in the community and technical school, curricula, supervised farming and employment experience programs, student activities, and evaluation of results.

690 RESEARCH.
(Educ. 690) F.W.S. Bundy, Hoerner, Kahler.
AGRICULTURAL ENGINEERING

Clarence W. Bockhop, Ph.D., Head of Department


Associate Professors: Craig E. Beer, Ph.D.; David B. Palmer, Ph.D.; Vernon M. Meyer, M.S.; Fred W. Roth, M.S.; Robert A. Saul, M.S.; Norval J. Wardle, Ph.D.; Stephen J. Marley, Ph.D.; Thomas A. Hoerner, Ph.D.

Assistant Professors: Willard R. Anderson, M.S.; Duane W. Mangold, Ph.D.; Larry Van Fossen, M.V.Ed.; J. Ronald Miner, Ph.D.

Instructors: Donald L. Ahrens, M.S.; Herbert E. Hansen, B.S.; Gary C. McVey, B.S.; Clarence E. Johnson, B.S.; Hilbert J. Hoof, M.A.; George E. Ayres, M.S.; Carl J. Bern, M.S.

Undergraduate Study

For 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 the 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 the degrees Master of Science, Master of Engineering, and Doctor of Philosophy with major work in soil and water resources, field power and machines, materials handling, crop conditioning and processing, agricultural structures and environment, and 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. 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 nine 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.

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 and Two-year programs in Agriculture 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. For Winter Quarter and Two-year programs in Agriculture 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. (2-3) Cr. 3. F. Prerequisite: Credit or classification in Math. 111, Phys. 221 and Stat. 201B. Introduction to concepts of energy and mass flow. Analysis of the atmospheric environments. Soil and water resources. Physical and biological properties of stored crops.

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. (3-6) Cr. 5. S. Prerequisite: 230, credit or classification in Agron. 154A and Bot. 410. Considerations in soil and water utilization. Analysis of the elements of the total plant environment. Concepts involved with crop production; including tillage, seeding, cultivation and harvesting.

254. METAL CONSTRUCTION AND MAINTENANCE. (2-4) Cr. 3. F.W.S. SSI. SSII. Selection and application of ferrous and non-ferrous 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. SSI. SSII. Selection of building materials and their application to agricultural construction.

259. MATERIALS AND PROCESSES. (0-6) Cr. 3. S. Prerequisite: Chem. 102. Properties and behavior of metallic and non-metallic materials. Welding, metallurgy, and heat treatment of ferrous and non-ferrous 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.

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; drawbar, power take-off, and traction devices.

1 A student cannot count credit for both 134 and 334 toward a degree.

2 A student cannot count credit for both 154 and 254 toward a degree.
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 oxy-acetylene and arc welding.

359. MACHINE CONSTRUCTION.
(0-6) Cr. 3. F.W.S.SSI.
Prerequisite: Chem. 101.
Oxy-acetylene 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; costs, quality of products, savings in labor; wiring the farm for work simplification, for safeguarding health and for recreation, servicing motors and electrical appliances.

371. WATER USE IN OUTDOOR RECREATION.
(3-0) Cr. 3. W.
Prerequisite: Phys. 111.
Recognition and definition of problem areas in outdoor recreation. Water sources, quantity and quality considerations, wastes disposal, irrigation and drainage, mapping.

372. OPERATION EQUIPMENT FOR OUTDOOR RECREATION SITES.
(3-3) Cr. 4. S.
Prerequisite: Phys. 112.
Evaluation of equipment and facilities for outdoor recreation sites. Selection of materials and evaluation of alternate designs. Application of electric power. Selection and care of support and maintenance equipment.

377. AGRICULTURAL STRUCTURES AND ENVIRONMENT.
(3-3) Cr. 4. W.
Prerequisite: 231, E.M. 325 and classification in M.E. 321.

401, 402, 403. SEMINAR.
(1-0) Cr. R. Yr.
Preparation, presentation and discussion of papers on agricultural engineering subjects.

412. ELECTRICITY IN FARMSTEAD MECHANIZATION.
(4-6) Cr. 3. SSI. Three weeks. 1970.
Prerequisite: Permission of instructor.
Planning the farmstead electrical systems for economy, work simplification and safety. Characteristics and selection 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.
(2-3) Cr. 3. F.W.S.
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. Off Campus. S.
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. Off campus. 5 weeks. F.W.S.SSI. I.
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.SI.
Prerequisite: 5 credits in mathematics.

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 culverts, conduits, and stilling basins. Hydraulics of pumps.

425. IRRIGATION AND DRAINAGE ENGINEERING.
(2-3) Cr. 3. S.
Prerequisite: 232, 424.

428. SPECIAL PROBLEMS.
Cr. 1 to 5. F.W.S.SSI. II.
H. Honors Program
P. Power and Machinery
Q. Structures and Environment
R. Electric Power and Processing
S. Soil and Water
T. Construction and Maintenance

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.
Mass and energy balances involved in the conditioning and storage of agricultural crops. Fans and air distribution in ducts. In-storage, heated-air, and supplemental-heat drying.

465. PROPERTIES AND PROCESSING OF AGRICULTURAL MATERIALS. (2-3) Cr. 3. S.

COURSES PRIMARILY FOR GRADUATE STUDENTS, major or minor, open to qualified undergraduates

524. EROSION AND SEDIMENT TRANSPORT. (3-0) Cr. 3. F.
Prerequisite: Math. 213 and one of the following: 424, C.E. 521, Geol. 460, Agron. 577.

528. SPECIAL TOPICS. Cr. 1 to 5. F.W.S.SSI,II.

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. Alt. W. Offered 1970.
Prerequisite: 424.
Critical analysis of the design and functional relations of soil and water conservation facilities, including experimental techniques.

533. AGRICULTURAL POWER AND MACHINERY. (3-0) Cr. 3. S.
Prerequisite: 346.
Critical analysis of power and equipment for agricultural production with emphasis on functional design requirements, and techniques for testing and evaluating performance.

534. 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

628. RESEARCH.
F.W.S.SSI,II.
N Crop Conditioning and Storage
P Power and Machinery
Q Structures and Environment
R Electric Power and Processing
S Soil and Water

637. SOIL DYNAMICS. (2-3) Cr. 3. W.
Prerequisite: E.M. 325, 345; Agron. 577 or C.E. 360.

661, 662, 663. SEMINAR. (1-0) Cr. 1 each. F.W.S.
Discussion of research problems, methods, procedures, and reports.

671. ADVANCED TOPICS IN WATER RESOURCES ENGINEERING. (C.E. 671) See Civil Engineering.
AGRICULTURE

Floyd Andre, Ph.D., Dean of Agriculture
Louis M. Thompson, Ph.D., Associate Dean

Professor: James J. Wallace, B.S.
Assistant Professors: Jack M. Alexander, M.S.; Harold R. Crawford, 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.

450. FARM OPERATION.
(3-4) Cr. F.W.S.S. I, II.

490. SPECIAL PROBLEMS.
Cr. 1-3. F.W.S.S.
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.
Current topics of importance in agriculture. Lectures by College of Agriculture staff and visitors.

AGRONOMY

John T. Pesek, Jr., Ph.D., Head of Department


Assistant Professors: W. Gale Biggs, Ph.D.; Cornells J. deMooy, Ph.D.; Alfred J. Englehorn, M.S.; Walter R. Fehr, Ph.D.; Thomas E. Fenton, Ph.D.; Clinton F. Hodges, Ph.D.; Oliver A. Knott, M.A.; Raymond P. Nicholson, B.S.; John W. Schafer, Ph.D.; Frederick R. Troeh, Ph.D.; Douglas C. Yarger, Ph.D.

Instructors: Charles L. Prior, B.S.; David L. Stamp, M.S.; D. Keith Whigham, B.S.

Undergraduate Study

For undergraduate curriculum in agronomy, see College of Agriculture, Curricula.

Students electing general agronomy as their 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, 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 electing soil science, crop science or climatology as their major will be prepared for both the above and graduate school. Those students who are reasonably certain of going on to graduate school should elect one of these majors.

All of the undergraduate courses described below are approved for major and minor credit in agronomy except 110, 114A, 114B, 154A, 154B and 400.

Graduate Study

The department offers major work for the degrees Master of Science and Doctor of Philosophy with specialization 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, and minor work to students taking major work in other departments. A non-thesis option is available for the M.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 pre-graduate 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.

Open to graduate students for minor credit only: 315, 354, 406, 415, 416, 444, 453, 455, 457, 464, 473, 483, 485.

COURSES PRIMARILY FOR UNDERGRADUATE STUDENTS

110. ORIENTATION IN AGRONOMY. (1-0) Cr. R. F.
Survey of different branches of agronomy

114. PRINCIPLES OF CROP PRODUCTION.
A: (1-6) Cr. 4. F.W.S.SSI.
B: (3-0) Cr. 3. W. For students in Winter Quarter Farm Operation Program only.
Introductionary principles of plant-soil-climate relationships in crop production.

154. FUNDAMENTALS OF SOIL SCIENCE.
A: (3-3) Cr. 4. F.W.S.SSI.
Prerequisite: A: Chem. 101.
B: (3-0) Cr. 3. For students in Winter Quarter Farm Operation Program only.
Introduction to principles of soil science Fundamentals of physical, chemical and biological properties of soils, the formation, classification, distribution, productivity and conservation of soils

206. INTRODUCTION TO METEOROLOGY. (Mteor. 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.
Plant characteristics, adaptation, management, processing and use of grain and forage crops Identification of major crop and weed species, grain and forage quality

310. SEMINAR. (1-0) Cr. 1. F.S.
Prerequisite: 206, 315, 354, Stat. 201A.
Interpretation of research data relating to soil-plant and soil-plant-climate relationships

314. TURFGRASS SCIENCE I. (Hort. 314) See Horticulture.

315. CROP PHYSIOLOGY. (4-0) Cr. 4. F.W.S.SSI.
Prerequisite: 114; Biol. 101; Chem. 231 recommended.
Physiological aspects of crop growth, application to cultural practices

354. SOIL FERTILITY. (3-3) Cr. 4. F.W.S.SSI.
Prerequisite: 154, 12 credits of chemistry.
Chemical, biological and physical properties of soils in relation to plant nutrition Principles relating to the use of lime, manure and fertilizers

357. FOREST SOILS. (For. 357) (4-3) Cr. 5. W.
Prerequisite: Chem. 231.
Formation, classification and occurrence of soils Physical, chemical and biological soil factors affecting forest growth.

400. AGRICULTURAL TRAVEL COURSE. (For. 306) (3-0) Cr. 3. S.
Prerequisite: Junior or senior classification, permission of instructor.
A American Tour Offered 1971
B European Tour Offered 1970
Students taking this course will be required to register also 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. (Mteor. 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

SEMINAR.
(1-0) Cr. 1. F.W.S.
Prerequisite: Senior classification.
Interpretation and presentation of research data relating to crop science

TURFGRASS SCIENCE II.
(Hort. 413) See Horticulture.

WORLD CROPS: ADAPTATION AND DISTRIBUTION.
(3-0) Cr. 3. F.W. Alt. SSI, offered 1971.
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.

PRINCIPLES OF CROP PRODUCTION AND MANAGEMENT.
(3-0) Cr. 3. Alt. SSI, offered 1970, three weeks.
Prerequisite: 114, Biol. 101, graduate classification.
Primarily for graduate students not majoring in agronomy. Application of principles of crop science and current research information in the solution of crop production problems.

PRINCIPLES OF PLANT BREEDING I.
(3-0) Cr. 3. F.
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 seed and cross-fertilizing species.

SOIL AND CROP MANAGEMENT.
(4-0) Cr. 4. F.W.S.SSI.
Prerequisite: 315 or 415, 354 and senior classification.
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.

SPECIAL PROBLEMS.
Cr. arr. F.W.S.SSI.
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 soils, climatic and crop production resources of the student's home country is suggested. Honors Program.

SEMINAR.
(1-0) Cr. 1. F.W.S.
Prerequisite: Senior classification.
Interpretation and presentation of research data relating to soil science.

SOIL FERTILITY AND FERTILIZERS.
(3-0) Cr. 3. S. Off-campus.
Prerequisite: 354 and graduate classification.
For graduate students not majoring in agronomy.

COURSES PRIMARILY FOR GRADUATE STUDENTS, major or minor, open to qualified undergraduates

MICROCLIMATOLOGY.
(3-0) Cr. 3. S.
Prerequisite: 206, or graduate classification. Shaw.

Agronomy 271

FERTILIZERS.
(3-0) Cr. 3. F.S.
Prerequisite: 354.
Types, properties, and production of fertilizers; choice and use of fertilizer in relation to soil properties, environmental conditions, crop requirements, and economic factors; out-of-town field trips.

PRINCIPLES OF SOIL FERTILITY, MANAGEMENT AND CONSERVATION.
(3-0) Cr. 3. Alt. SS. Offered 1971. Three weeks.
Prerequisite: 154, Chem. 231.
Primarily for graduate students not majoring in agronomy. Application of principles of soil science in the interpretation and use of recent research, relating to problems in soil management, fertility and conservation.

SOIL CHEMISTRY AND PHYSICS.
(3-3 or 3-0) Cr. 3 or 4. F.
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.

SOIL RESOURCE CONSERVATION.
(2-3) Cr. 3. F.S.
Prerequisite: 354.

SOIL GENESIS AND SURVEY.
(4-3) Cr. 5. F.S.
Prerequisite: 154.
Development, characteristics, and identification of soils; study of soil profiles; theory and practice of soil mapping; interpretation and utilization of soil survey information; two 2-day field trips.

WORLD SOIL RESOURCES.
(2-3 or 2-0) Cr. 3 (2 cr. and no lab for students with credit in 154A or 367) Alt. W. Offered 1971.
Prerequisite: Chem. 101; Junior or senior classification.
Properties of soils; world soil geography; present and potential productivity of soils in various continents, and factors influencing their utilization.

AGRO-MICROBIOLOGY.
(Bact. 485) (4-3) Cr. 5. S.
Prerequisite: 154, Bact. 300 or 304.

The heat exchange near the ground. Relation of topography and plant cover to the micro-climate. Modification of micro-climate by agricultural operations.
COURSES FOR GRADUATE STUDENTS, major or minor

600. SEMINAR.
(1-0) Cr. 1. F.W.S.
Reports and discussions of recent literature and current investigations
A Crops Carlson, Fehr, Wilsey.
B Soils Black.
C Plant-Soil-Climate Relationships Shaw.

606. RESEARCH IN AGRO-CLIMATOLOGY.
F.W.S.S. (1) Biggs, (2) Shaw.
Consultation with instructor, exhaustive examination of the literature pertaining to and original thought on a research problem of special interest to the student

609. CONFERENCE IN AGRO-CLIMATOLOGY.
(0-1) Cr. 1. F.W.S.S. Shaw.
Consultation with instructor, special problems and or reading assigned in consultations with the instructor on which the student reports

615. ENVIRONMENTAL CROP PHYSIOLOGY.
(3-0) Cr. 3. S.
Prerequisite: Fundamental background in plant physiology and crop science. Shibles.
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, Mitchell, Shibles, 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.
Cyto genetics in plant breeding. Topics include...
ANIMAL SCIENCE

L. N. Hazel, Ph.D., Head of Department


Instructors: James N. Glenn, B.S.; Alfred J. Stein, B.S.; David B. Williams, B.S.
Undergraduate Study

For undergraduate curricula in animal science and dairy science, see College of Agriculture, Curricula.

Studies leading to the degree Bachelor of Science in animal science and in dairy science are designed to give the student broad based training in animal agriculture, with emphasis on its scientific and technical aspects, together with its interaction with other disciplines. Breadth of preparation is a basic feature of each curriculum. Communicative, business, and sociological preparation for careers in animal agriculture or its many related fields is included in the core curricula.

In addition to preparation for a wide range of agricultural careers, the animal science and dairy science curricula provide the opportunity for basic work leading to enrollment in schools of veterinary medicine, medicine, law, business, and graduate study in closely related fields of biological science.

Graduate Study

The department offers major work for the degrees Master of Science and Doctor of Philosophy in breeding, meats, nutrition and reproduction which requires original research and a thesis. Advanced graduate study in meats is offered as a joint major in meat science and food technology. Minor work is offered in breeding, meats, nutrition and reproduction to students with a major 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.

The foreign language requirement for the degree Master of Science may be waived upon recommendation of the student's committee and approval by the department head.

Candidates for the degree Doctor of Philosophy in animal science are required to pass the Educational Testing Service examination in one foreign language (biology section) determined by the candidate's graduate committee with a minimum score of 460 prior to the written preliminary examination. In exceptional cases, the graduate committee may recommend that the requirements be changed to meet the needs of the individual candidate.

Graduate programs in animal science include supporting work in other areas such as agronomy, anatomy, bacteriology, biochemistry, chemistry, dairy and food industry, economics, genetics, physiology and statistics.

Prerequisite to major graduate work is the completion of an undergraduate program in animal science, dairy science or a related science. Basic courses in chemistry, mathematics and zoology are necessary in all animal science graduate work.

Open to graduate students for minor credit only: 318, 319, 350, 351, 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.SSI.
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. (2-2) Cr. 3. 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. S.
Prerequisite: 114 or F. & N. 107.
Composition of meat and its nutritive value. Selection, grading, identifying, curing and freezing meats.

200. LIVESTOCK HUSBANDRY PRACTICES. (0-4) Cr. 2. SSI.
Practical problems, demonstrations, participation in skills and practices encountered in the care, handling and exhibiting of farm livestock. For special groups.

214. ECOLOGY AND APPRECIATION OF MEAT ANIMAL BREEDS. (2-2) Cr. 3. F.W.S.
Prerequisite: Sophomore standing.
Breeds of beef cattle, sheep and swine, their development, evaluation, use and adaptability in commercial livestock production.
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.

235. DAIRY CATTLE BREEDING. 
(2-2) Cr. 3. F.W.S.SII. 
Prerequisite: 114. 

271. LIGHT HORSE HUSBANDRY. 
(1-4) Cr. 3. F.S.SSI. 
Prerequisite: 115. 
Feeding, breeding and selection, care, handling, training and marketing of light horses and ponies. English and Western equitation. Field trips.

315. FUNDAMENTALS OF NUTRITION. 
(4-0) Cr. 4. F.W.S.SSI. 
Prerequisite: Chem. 231 or equivalent; V. Phys. 264 recommended. 
Digestion and metabolism of carbohydrates, fats, proteins, minerals and vitamins. Measures of energy.

319. APPLIED ANIMAL NUTRITION. 
(3-0) Cr. 3. F.W.S.SII. 
Prerequisite: 318. 
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.

335. DAIRY CATTLE SELECTION. 
(0-6) Cr. 2. S. 
Prerequisite: 235. 
Selection of 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. 
Prerequisite: Gen. 301, Stat. 201 or 201A. 
An application of genetic principles to animal improvement. Selection and systems of mating for farm animals. The use and value of performance testing.

351. APPLIED ANIMAL BREEDING. 
(2-2) Cr. 3. F.W.S. 
Prerequisite: 350. 

370. MEAT MERCHANDISING AND MARKETING. 
(3-3) Cr. 4. W. 
Prerequisite: 271. 
Effect of nutrition, breeding and management on qualitative and quantitative aspects of meat production. Meat merchandising and marketing practices. One-day field trip.

400. AGRICULTURAL TRAVEL COURSE. 
Cr. 4 (Agron. 400, Cr. 4, also required for students taking this course) SS. 
Prerequisite: Junior classification and or permission of Instructor. 
A American Tour Offered 1971. 
B European Tour. Offered 1970. 
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.

403. MARKETING LIVESTOCK AND MEAT. 
(Econ. 403) See Economics.

409. MARKET LIVESTOCK AND MARKETING PROCEDURES. 
(2-0) Cr. 2. S. 
Prerequisite: 271. 
Classifying, grading, and evaluating cattle, hogs, and sheep for market. Kinds of markets and marketing procedures. Field trips.

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 non-ruminant 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.

425. PORK PRODUCTION AND MARKETING. 
(3-0) Cr. 3. F.W.S. 
Prerequisite: 319, 350; 351 recommended.

427 BEEF PRODUCTION AND MARKETING. 
(3-0) Cr. 3. F.W.S. Alt. SSI. Offered 1970 
Prerequisite: 319, 350; 351 recommended.

429. SHEEP PRODUCTION AND MARKETING. 
(2-2) Cr. 3. W.S. 
Prerequisite: 319.

431. ANIMAL REPRODUCTION I. 
(3-2) Cr. 4. F.W.S. 
Prerequisite: V. Phys. 264 or Zool. 355.

434. MILK PRODUCTION AND HERD MANAGEMENT. 
(3-0) Cr. 3. F.W. 
Prerequisite: 319. 
Ration preparation and computations. Evaluation of feed sources, feed additives and herd management systems.

436. DAIRY PROBLEMS. 
(3-0) Cr. 3. W. 
Prerequisite: 350, 434. 
Seminar and discussion of current problems for the dairyman.

437. MILK SECRETION. 
(3-0) Cr. 3. F. 
Prerequisite: 319, V. Phys. 264. 
Development, structure and functional processes of the mammary gland.

470. MEAT SCIENCE. 
(3-3) Cr. 4. S. 
Prerequisite: 170. 
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. 1-7. F.W.S.;  B: Cr. 1-6. F.W.S.; C: Cr 1-4. F.W.S.
Prerequisite: Permission of Instructor.
A Meat Animals and Horses
B Dairy Cattle
C Meats
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. F.W.S.
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
D Senior Seminar
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.
The scientific method in animal research. Recognition of important problems in the livestock industry. Emphasis upon planning and conducting animal experiments and interpretation of the observed results.

509. EVALUATION OF LIVESTOCK MANAGEMENT SYSTEMS.
(0-6) Cr. 3. S.
A critical appraisal of the factors and their interrelationships, which contribute to the efficiency of various livestock management systems.

519. ADVANCED RUMINANT NUTRITION I.
(3-0) Cr. 3. S.
Prerequisite: 319. B.&.B. 304.
Digestion, absorption and metabolism of nutrients as related to maintenance growth, fattening, reproduction and lactation in the non-ruminant animal.

520. ADVANCED RUMINANT NUTRITION II
(2-3) Cr. 3. Alt. F. offered 1970.

COURSES FOR GRADUATE STUDENTS, major or minor

603. SEMINAR IN ANIMAL NUTRITION AND MEATS.
(Po.S. 603) (1-0) Cr. 1. F.W.S.
Prerequisite: Permission of Instructor.
Discussion of current literature, preparation and submission of abstracts.

605. METHODS AND TECHNIQUES IN ANIMAL NUTRITION EXPERIMENTATION.
(Po.S. 605) (2-3) Cr. 3. F.
Prerequisite: Stat. 401.
Methods and techniques in planning and conducting nutrition experiments with poultry, swine, cattle and sheep. Includes visits to experimental facilities.

618. ADVANCED NUTRITION—MINERALS AND VITAMINS.
(4-0) Cr. 4. F.
Prerequisite: B. & B. 406 or equivalent.
The role of vitamins and minerals in mammalian intermediary metabolism. Integration of cellular biochemistry and physiology of vitamins and minerals.

619. ADVANCED NUTRITION—PROTEIN.
(3-0) Cr. 3. W.
Prerequisite: B. & B. 406 or equivalent.
Digestion, absorption and intermediary metabolism of amino acids and protein. Integration of cellular biochemistry and physiology of mammalian protein metabolism.

620. ADVANCED NUTRITION—ENERGY.
(3-0) Cr. 3. S.
Prerequisite: B. & B. 406 or equivalent.
Energy constituents of feedstuffs and energy needs of animals as related to cellular biochemistry and physiology. Interpretations of classical and current research.
650. POPULATION GENETICS.
(Gen. 660) (3-0) Cr. 3. S.
Prerequisite: Stat. 402.
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.
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.

670. MOLECULAR BIOLOGY OF MUSCLE.
(3-0) Cr. 3. Alt. F. Offered 1970.
Prerequisite: B. & B. 406 or 503 or permission of instructor. 470 recommended. Microstructure and chemical composition of muscle tissue. Chemistry and biosynthesis of muscle and connective tissue protein. Molecular aspects of muscle contraction.

671. APPLIED MUSCLE BIOLOGY.
Prerequisite: 670.
Physiological factors affecting muscle properties and rigor mortis. Lipid deposition in muscle. Chemical and physical changes in muscle components and their relationship to muscle as a food. Discussion of currently active research areas.

680. MODERN VIEWS OF NUTRITION.
(Po. S. 680, B. & B. 680, F. & N. 680) (2-0) Cr. O. W.
A seminar presenting current concepts in nutrition and related fields. Required for all graduate students in nutrition.

690. RESEARCH.
A Animal Breeding
B Animal Nutrition
C Meat Animal Production
D Dairy Production
E Meat Science and Muscle Biology
F Animal Reproduction

APPLIED ART

Clair B. Watson, M.F.A., Head of Department

Professors: Harriet Adams, M.A.; Mabel C. Fisher; Marjorie S. Garfield, M.F.A.; Mary L. Meixner, M.A.; Janet L. Navin, M.S.

Associate Professors: Alice Davis, M.A.; 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.

Four majors are offered for men and women in the Applied Art Department: advertising design, art education, general applied art and crafts, and interior design.

I. Advertising design. This major prepares students for positions in small or large advertising agencies; for work requiring precision skills such as layout and advertising design, poster art, greeting card and gift wrap designing, television art, packaging, store display, and fashion illustration.

II. Art education. The major in art education is planned for students interested in preparation for teaching art at both elementary and secondary levels, grades kindergarten through fourteen. Students may enroll in this major as sophomores but must apply to and be accepted by the departmental committee on selection and the Committee on Academic Standards of the College of Education in order to advance to the teacher education program. For the teacher education program, including requirements for teaching certification, see College of Education.
III. General applied art and crafts. This major is planned for the art student who may prefer a balanced art program along with a strong emphasis in the area of crafts. A broad background in design, drawing, and art history, and varied crafts media would permit men or women to have shops and market quality crafts in weaving, metal, jewelry, and wood, or to teach in community and welfare workshops or in adult education.

IV. Interior design. This major is planned for art students who plan to enter the field of interior design and decoration professionally.

Students applying for advanced credit must submit representative work.

Graduate Study

The department offers major work for the degree Master of Arts in Advertising Design, Art Education, General Art and Crafts, and Interior Design, as well as minor work to students taking major work in other departments.

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.

The foreign language requirement for the degree Master of Arts may be waived upon recommendation of the department head.

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: 406, 407, 424, 435, 445, 446, 464, 465, 467, 468, 484, 485, 486, 490, 500

### COURSES PRIMARILY FOR UNDERGRADUATE STUDENTS

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credit Hours</th>
<th>Prerequisite(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
<td>PERSPECTIVE DRAWING.</td>
<td>(0-6) Cr. 2 F.W.S.SSI.SSI.I</td>
<td>Use of drawing instruments for scale and measured drawing in relation to applied art</td>
</tr>
<tr>
<td>103</td>
<td>DESIGN I.</td>
<td>(2-6) Cr. 4 F.W.S.SSI.SSI.I</td>
<td>Creative problems in design and color with emphasis on art elements and principles</td>
</tr>
<tr>
<td>104</td>
<td>DESIGN II.</td>
<td>(0-9) Cr. 3 F.W.S.SSI</td>
<td>Two and three dimensional forms in design, varied materials and techniques</td>
</tr>
<tr>
<td>107</td>
<td>LETTERING I.</td>
<td>(0-9) Cr. 3 F.W.S.SSI</td>
<td>Basic letter forms. Direct lettering with pen and brush</td>
</tr>
<tr>
<td>150</td>
<td>DRAWING I.</td>
<td>(0-9) Cr. 3 F.W.S.SSI</td>
<td>Freehand drawing and perspective in various media. Applied art majors should enroll by the fall quarter of the sophomore year</td>
</tr>
<tr>
<td>200</td>
<td>ART FOR THE ELEMENTARY SCHOOL.</td>
<td>(1-6) Cr. 3 F.S.</td>
<td>Experimentation with materials and processes in two and three dimensions suitable for the teaching of arts and crafts in the elementary school</td>
</tr>
<tr>
<td>203</td>
<td>COLOR.</td>
<td>(2-3) Cr. 3 W.S.</td>
<td>Introduction to color theory and practical experiences in the laboratory</td>
</tr>
<tr>
<td>207</td>
<td>LETTERING II.</td>
<td>(0-9) Cr. 3 W.S.</td>
<td>Applied problems in letter design, techniques and methods</td>
</tr>
<tr>
<td>213</td>
<td>FASHION ILLUSTRATION I.</td>
<td>(0-9) Cr. 3 F.W.S.</td>
<td>Illustration of the fashion figure, costume rendering, layout</td>
</tr>
<tr>
<td>214</td>
<td>FASHION ILLUSTRATION II.</td>
<td>(0-9) Cr. 3 S.</td>
<td>Advanced work in rendering the costumed figure, accessories, layout</td>
</tr>
<tr>
<td>233</td>
<td>WATERCOLOR.</td>
<td>(0-9) Cr. 3 F.W.S.SSI</td>
<td>Painting in watercolor. Abstract, still life, landscape</td>
</tr>
<tr>
<td>234</td>
<td>INTERIOR SKETCHING.</td>
<td>(0-9) Cr. 3 F.W.</td>
<td>Varied techniques in rendering interiors</td>
</tr>
<tr>
<td>250</td>
<td>DRAWING II.</td>
<td>(0-9) Cr. 3 F.W.S.</td>
<td>Study of composition and techniques in various media. Drawing of diversified subject matter</td>
</tr>
<tr>
<td>261</td>
<td>INTERIOR HOUSE DESIGN I.</td>
<td>(1-4) Cr. 3 F.W.S.SSI.I</td>
<td>Principles of design and color applied to the exterior, interior and furnishings of the house</td>
</tr>
</tbody>
</table>
262. INTERIOR HOUSE DESIGN II.
(0-9) Cr. 3. S.
Prerequisite: 261.
Problems in design and color in the interior; analysis of home furnishings and housing design.

306. ADVERTISING DESIGN I.
(0-9) Cr. 3. W.S.
Prerequisite: 107; for non-majors, 103.
Introductory layout design. Symbol, poster, direct mail, packaging

324. FIGURE DRAWING.
(0-9) Cr. 3. F.W.
Prerequisite: 250.
Artistic anatomy, figure drawing and portrait in various media.

335. TEXTILE DESIGN I.
(1-9) Cr. 4. F.W.S.SI, SSII.
Prerequisite: 104; for non-majors, 103.
Creative design in block print, stencil, stitching, batik and silk-screen. Comparative analysis of designers and processes

344. WEAVING I.
(0-9) Cr. 3. F.W.S.SI, SSII.
Prerequisite: 103.
Fundamentals of weaving. Use of table looms and non-loom processes

345. CRAFTS I.
(0-12) Cr. 4. F.W.S.SI.
Prerequisite: 104.
Manipulation of metal, wood, enamels and experimental media in two- and three-dimensional design

361. HISTORY OF FURNITURE I.
(3-0) Cr. 3. F.W.
Ancient, classic and medieval furniture styles and interior architectural backgrounds

362. HISTORY OF FURNITURE II.
(3-0) Cr. 3. S.
Prerequisite: 361.
Renaissance and modern furniture and backgrounds

384. SURVEY OF ART.
(3-0) Cr. 3. F.W.S.SI.
Prerequisite: Sophomore standing.
Survey of the art of all ages, emphasizing art as an expression of cultures

393. CERAMICS.
(0-9) Cr. 3. F.W.S.SI.
Prerequisite: 104.
Introduction to clay construction, decoration, and firing.

401. SENIOR STUDY TOUR.
Cr. 1. S.
Prerequisite: applied art senior classification.
Visit professional studios, retail establishments, art museums

404. SEMINAR.
Cr. 1 or arr.
Prerequisite: 12 credits in applied art.
Art discussion.

406. ADVERTISING DESIGN II, III.
(0-9) Cr. 3. 406; F.S.; 407; W.S.
Prerequisite: 250, 306, Psych. 250.
Creative problems developing design, illustration and layout in various media for specific forms of visual communication

415. ART METHODS FOR THE ELEMENTARY SCHOOL.
(3-0) Cr. 3. F.
Prerequisite: Classification in art education, C.D. 357, Ed. Ed. 364.
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.
(3-0) Cr. 3. W.
Prerequisite: Classification in art education.
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. F.S.
Prerequisite: Classification in art education, and satisfactory completion of all courses required in 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: 415.
Supervised teaching at the elementary school level.

424. OIL PAINTING.
(0-9) Cr. 3. F.S.
Prerequisite: 233, 250.
Introduction to oil painting and new media

435. TEXTILE DESIGN II.
(0-9) Cr. 3. W.S.SI.
Prerequisite: 335.
Applied weaving with emphasis on designing for specific, useful, or decorative fabrics

445. CRAFTS II.
(0-9) Cr. 3. F.S.SI.
Prerequisite: 345.
Development of individual projects in crafts with emphasis on design.

446. JEWELRY.
(0-9) Cr. 3. F.W.SI.
Prerequisite: 345.
Jewelry design.

464. INTERIOR DESIGN I.
(1-6) Cr. 3. F.W.
Prerequisite: 234, 281.
Selection of color, fabrics, furniture and accessories; room planning and presentation.

465. INTERIOR DESIGN II.
(1-6) Cr. 3. F.W.
Prerequisite: 464.
Interior design; planning of a professional nature; cost analysis.

466. APPRENTICESHIP.
Cr. 9. SSI following the junior year.
Prerequisite: 261, 335, 361, 384, 464, 465.
Practical interior design shop experience.

467. INTERIOR DESIGN III.
(1-6) Cr. 3. F.S.
Prerequisite: 465.
Advanced decorative planning, commercial and contract problems.

468. PROFESSIONAL INTERIOR DESIGN PROCEDURES.
(1-4) Cr. 2. F.
Prerequisite: 465, 467.
Written specifications; cost of materials and general procedures for interior designers.
484. HISTORY OF ORNAMENT.
(3-0) Cr. 3. W.
A study of historic ornament with emphasis on the arts of the past and their application to the present.

485. MEDIEVAL, RENAISSANCE AND ORIENTAL ART.
(3-0) Cr. 3. W.
History of European art from early Christian times to 1800, Oriental art.

486. MODERN ART.
(3-0) Cr. 3. S.

490. SPECIAL PROBLEMS.
Cr. 2-3. F.W.S.SSI.
Prerequisite: Existing course offerings, reservation and permission of instructor.
A Painting and Composition
B Textile Design
C Craft Design
D Ceramics
E Interior Design
F Advertising Design
G Fashion Illustration
H Honors

COURSES FOR GRADUATE STUDENTS, major or minor, open to qualified undergraduates

500. SHORT COURSE.
Cr. arr. S.SSI.
Prerequisite: Permission of Instructor.

535. ADVANCED TEXTILE DESIGN.
(0-9) Cr. 3. S.SSI.

COURSES FOR GRADUATE STUDENTS, major or minor

590. ADVANCED DESIGN.
Cr. arr. F.W.S.SSI.
Prerequisite: Bachelor's degree in applied art or satisfactory evidence of ability.
A Painting and Composition Adams, Meixner
B Textile Design Navin.
C Craft Design Held, Rogers.
D Ceramics

600. SEMINAR.
Cr. arr. F.W.S.

614. RESEARCH.
F.W.S.SSI.SSI.

ARCHITECTURE
Raymond D. Reed, M.Arch., Head of Department

Professors: Karol J. Kocimski, M. Arch.; Lawton M. Patten, B. Arch.; Vernon F. Stone, B. Arch.

Associate Professors: Arthur E. Burton, M.S.; Tadeus M. Janowski, M.Arch.; Marion J. Kitzman, M.A.; Donald I. McKeown, M.S.; Bernard J. Slater, M.S.


Undergraduate Study

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.
Cooperative Study

It is essential that the architect’s academic preparation be tempered with professional experience and judgment. Cooperative studies with architecturally related firms to satisfy in part the professional internship requirements are normally taken upon completion of the Bachelor of Arts 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, 341, 342, 343, 361, 362, 363, 444, 445, 446.

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

124. SURVEY OF ARCHITECTURE.
(2-0) Cr. 2. F.W.S.
An introduction to the appreciation and understanding of architecture as a part of our physical environment and cultural heritage. For students not majoring in architecture

314, 315, 316. DESIGN I.
(0-9) Cr. 3 each. Yr.
Introduction of factors shaping the human environment. Human perception and reaction, time, motion, spatial sequences and relationships. Projects in architectural design. Integration of systems related to architectural design. Problem solving procedures.

321, 322, 323. HISTORY OF ARCHITECTURE I.
(3-0) Cr. 3 each. Yr. S.S.
Prerequisite: Hist. 203.
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.

334. DRAWING I.
(0-6) Cr. 2. F.W.S.S.
Beginning drawing and sketching in pencil and charcoal. Study of proportion, perspective and form.

335. DRAWING I.
(0-6) Cr. 2. W.S.S.
Prerequisite: 334.
Freehand drawing, various media. Life drawing

336. DRAWING I.
(0-6) Cr. 2. S.S.S.
Prerequisite: 335.
Freehand drawing, extended to color theory and water color. Life drawing

341, 342, 343. ARCHITECTURAL TECHNOLOGIES I.
341: (2-3) Cr. 3. F; 342: (2-3) Cr. 3. W; 343: (1-6) Cr. 3. S.
Prerequisite: 341: Phys. 111; 342: 341; 343: 342.

347. CERAMIC CONSTRUCTION MATERIALS.
(Cer. E. 347) See Ceramic Engineering.

361. RESIDENTIAL ARCHITECTURE.
(3-0) Cr. 3. F.
Principles of planning and design of houses with consideration given to site selection, financing, planning, equipment, materials and methods of construction.

362. RESIDENTIAL ARCHITECTURE.
(3-0) Cr. 3. W.
Principles of planning and design of individual unit housing with consideration given to the social, economic and political factors.

363. HOUSING.
(3-0) Cr. 3. S.
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. 
(0-12) Cr. 4 each. Yr.
Prerequisite: 316.
Individual and group projects of intermediate scope. Economic, technical, regional and sociometric variables. Recognition and synthesis of subjective and objective values. Field trips 430. ADVANCED FREEHAND DRAWING.
(0-6) Cr. 2 each time elected. F.W.S.S.
431, 432, 433. ARCHITECTURAL DELINEATION.
(0-9) Cr. 3 each. SS.
Prerequisite: 4 credits in freehand drawing. Methods, media, techniques of visual communication. Drawings and models.
444, 446, 447. ARCHITECTURAL TECHNOLOGIES II.
(M.E. 446, 447) (2-3) Cr. 3 each. Yr.
460. SPECIAL PROBLEMS IN ARCHITECTURE.
(0-6 to 27) Cr. 2 to 9. F.W.S.S.
Prerequisite: Permission of department head. Investigation of problems of special interest to the student.

COURSES FOR GRADUATE STUDENTS, major or minor.
611, 612, 613. RESEARCH AND DESIGN IV.
(0-21) Cr. 7 each. Yr.
Prerequisite: 516.
Individual and group solutions to large scale architectural problems of complex, multiple or specialized requirements. Student competitions. Field trips.

BACTERIOLOGY
William R. Lockhart, Ph.D., Chairman of Department

Professors: Lloyd R. Frederick, Ph.D.; Paul A. Hartman, Ph.D.; Loyd Y. Quinn, Ph.D.
Associate Professors: Donald P. Durand, Ph.D.; John G. Holt, Ph.D.; Peter A. Pattee, Ph.D.; George W. Reinbold, Ph.D.; Homer W. Walker, 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, 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: 200 or Biol. 101A, 300, 320, 330, 340 and 404. The following courses are desirable as supporting work: Chem. 211, 334, 335, 336; Phys. 111, 112, 113; Math. 110; Stat. 201; 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 major work for the degrees Master of Science and Doctor of Philosophy in soil microbiology, pathogenic bacteriology and immunology, food, dairy 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 Dairy and Food Industry, 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: 350, 412, 413, 414, 450, 485.

**COURSES PRIMARILY FOR UNDERGRADUATE STUDENTS**

**200. INTRODUCTORY BACTERIOLOGY I.**
(3-0) Cr. 3. F.W.S. SS.
Prerequisite: Chem. 101.
Description of bacteria, scope of bacteriology, relationships of bacteriology to personal and community health, industry, agriculture, role of bacteria in everyday life.

**300. INTRODUCTORY BACTERIOLOGY II.**
(Biol. 300)
(2-4) Cr. 3. F.W.S.
Prerequisite: 200 or Biol. 101A; Chem. 231 or 334.
Study and cultivation of bacteria; laboratory methods in bacteriology

**304. GENERAL BACTERIOLOGY.**
(3-6) Cr. 5. F.W.S. SS.
Prerequisite: Chem. 231 or 334.
Study and cultivation of bacteria; applications of bacteriology in agriculture and industry, relation of bacteria to diseases of man, animals and plants. Students may not receive credit for both 300 and 304.
320. MICROBIAL DIVERSITY.  
(3-6) Cr. 5. F.  
Prerequisite: 300 or 304.  
Survey of the microbial world, study, isolation, and cultivation of the major groups of bacteria: principles of bacterial taxonomy.

330. PATHOGENIC BACTERIA.  
(3-6) Cr. 5. W.  
Prerequisite: 320.  
Study of pathogenic bacteria by clinical laboratory techniques: serological methods; tissue cell culture.

340. BACTERIAL PHYSIOLOGY.  
(3-6) Cr. 5. S.  
Prerequisite: 330.  
Structure and function of bacteria, introduction to bacterial metabolism and genetics.

350. DAIRY MICROBIOLOGY.  

404. SPECIAL PROBLEMS.  
Cr. 1 to 5. F.W.S. SS.  
Prerequisite: 340 and permission of instructor.  
H. Honors Program

412. FOOD PRESERVATION.  

413. MICROORGANISMS IN FOODS.  
(D.F.I. 413) (3-0 or 3-6) Cr. 3 or 5. W.  
Prerequisite: 300 or 304.  
The normal microbial flora of foods; food infections and intoxications; microbiological indicators of contamination of foods.

414. FOOD, MILK AND WATER SANITATION.  

485. AGRO-MICROBIOLOGY.  
(Agron. 485) See Agronomy.

COURSES PRIMARILY FOR GRADUATE STUDENTS, major or minor, open to qualified undergraduates

509. GENERAL VIROLOGY.  
(Bot. 509, V.Micr. 509)  
(3-0) Cr. 3. W.  
Prerequisite: Permission of instructor.  
A study of the principles of viral, 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: 300 or 304.

575. IMMUNOLOGY.  
(3-6) Cr. 5. S.  
Prerequisite: 300 or 304.  
Theories of immunity and immunization; preparation of vaccines and antisera; antigen-antibody reactions.

585. SOIL MICROBIOLOGY AND BIOCHEMISTRY.  
(Agron. 585) See Agronomy.

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. F.W.S. SS.  
Prerequisite: Permission of instructor.  
Selected topics of current interest.

615. BACTERIAL VIRUSES.  
(3-6) Cr. 5. S.  
Prerequisite: 509 or 603.  
Structure, function and genetics of bacterial viruses and virus-like agents; host-virus interactions.

620. BIOCHEMICAL GENETICS.  
(Gen. 620) See Genetics.

621. BACTERIAL GENETICS.  
(Gen. 621) (2-4) Cr. 3. F.  
Prerequisite: 603.  
Isolation, characterization and uses of mutant bacteria, mechanisms of genetic exchange and their application to genetic and biochemical analysis of bacteria

646. BACTERIAL CYTOLOGY.  
(3-3) Cr. 4. Alt. W.  
Prerequisite: 603.  
Chemical and physical structure of the bacterial cell; methods in microscopy of bacteria.

656. SYSTEMATIC DAIRY MICROBIOLOGY.  

660. SYSTEMATIC BACTERIOLOGY.  
(3-3) Cr. 4. Alt. W.  
Prerequisite: 603.  
Theories of classification; applications of molecular and numerical data, principles of bacteriological nomenclature.

675. ADVANCED IMMUNOLOGY.  
(3-6) Cr. 5. Alt. F.  
Principles and methods of immunochemistry, immunogenetics, and immunocytoology.

678. TISSUE CELL CULTURE RESPONSES TO PATHOGENS.  
(3-6) Cr. 5. Alt. F.  
Prerequisite: 603.  
Methods for tissue cell culture propagation, measurement of tissue cell culture metabolism; comparison of pathogen-free and infected cultures

690. RESEARCH.

698. SEMINAR IN CELL BIOLOGY.  
(B. & B. 698, Bot. 698E, Gen. 698, Zool. 698)  
See Zoology.
BIOCHEMISTRY AND BIOPHYSICS

Dexter French, Ph.D., Chairman of Department

Professors: Emerson W. Bird, Ph.D.; Paul A. Dahm, Ph.D.; Hebert J. Fromm, Ph.D.; Donald J. Graves, Ph.D.; Earl G. Hammond, Ph.D.; David Metzler, Ph.D.; Martin Roepke, Ph.D.; Frederick G. Smith, Ph.D.


Assistant Professors: Roger L. Heintz, Ph.D.; John F. Robyt, Ph.D.; Chuen-Mo To, Ph.D.; Bernard White, Ph.D.

Instructor: Deane R. Clark, M.S.; Marta Copley, M.S.

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. 100, 201, 401 (or 501, 502, 503), 461, 511; Chem. 114, 115, 224, 325, 326, 327, 330, 331, 332, 333; Math. 110, 111, 112, 213; Phys. 221, 222, 223; Biol. 101, 101A, 103; Zool. 106, 355 or Bot. 107, 310; Bact. 304; Gen. 301.

Biophysicists usually include the following basic courses in their programs: B. & B. 461; Phys. 221, 222, 223, 311, 421, 422, 423; Math. 110, 111, 112, 213, 321, 322, 409, 410; Chem. 102A, 103 (or 107, 108) 211, 321, 322, 323, 334, 335; Biol. 101, 101A, 103; Zool. 106, 355 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 major work for the degrees Master of Science and Doctor of Philosophy in biochemistry and 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 and physics, and if possible, biology. Some students may find it necessary to acquire additional training at the intermediate level before undertaking graduate work.

Open to graduate students for minor only: 304, 305, 347, 348, 349, 401, 404, 405, 406, 461, 490.
## COURSES PRIMARILY FOR UNDERGRADUATE STUDENTS

**100. INTRODUCTION TO BIOCHEMISTRY.**  
(1-0) Cr. 1. F.W.S.  
Introduction to the various areas of biochemistry to familiarize biochemistry majors with the field. Open only to biochemistry majors.

**201. THE CHEMISTRY OF LIFE.**  
(3-0) Cr. 3. F.  
Prerequisite: Chem. 103 or 108; high school biology.  
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. BIOCHEMISTRY.**  
(3-0) Cr. 3. F.W.S.  
Prerequisite: A course in organic chemistry.  
Brief survey of biochemistry including the 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.  
Must be accompanied by 314 and 315 for veterinary medicine students. Not accepted for credit toward a chemistry, biochemistry or biophysics major. 304: Chemistry of the animal body, digestion; absorption. 305: Metabolism of carbohydrates, lipids, proteins, and minerals.

**311. LABORATORY IN BIOCHEMISTRY.**  
(0-6) 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; 315: 314.  
Designed to accompany B&H 304, 305 and V. Phys 314, 315. Not accepted for credit toward a chemistry, biochemistry, or biophysics major.

*347. 348. DAIRY CHEMISTRY.**  

*349. FOOD CHEMISTRY.**  
(D.F.I. 349)  
(3-6) Cr. 5. S.  
Prerequisite: Chem. 211, 335.  
Application of proximate and physicochemical methods of analysis to the general composition of common food types and to determination of coloring materials, preservatives, and metals in foods.

**401. INTRODUCTION TO BIOCHEMISTRY.**  
(3-0) Cr. 3. S.  
Prerequisite: Classification or credit in Chem. 333 or 335, Phys. 113 or 223.  
A qualitative but rigorous introduction to biochemistry, with emphasis on the cellular and subcellular aspects. Designed for undergraduate physical, biological, or engineering science majors. Topics include: energy transductions, metabolism, biopolymers, enzymes, organelles, and regulatory mechanisms.

**404, 405, 406. SURVEY OF BIOCHEMISTRY.**  
(3-0) Cr. 3 each. 404: W.; 405: S.; 406: F.  
Prerequisite: Chem. 335 or equivalent; Chem. 336 recommended.  
General survey of biochemistry 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 materials, intermediary metabolism and synthesis of biopolymers. 406: Metabolism of differentiated cells; membranes and cell walls; biosynthesis of metalloporphyrins and other prosthetic groups, cofactors and vitamins, and other topics.

**461. INTRODUCTION TO BIOPHYSICS.**  
(3-0) Cr. 3. F.  
Prerequisite: Chem. 103, Gen. 301, Phys. 113 or 223.  
An introduction to the 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 TOPICS.**  
Cr. arr.  
H Honors Program

**495. UNDERGRADUATE RESEARCH.**  
Cr. 2-5 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.

*Offered by the College of Agriculture. Courses not marked by an asterisk are offered by the College of Sciences and Humanities.

## COURSES PRIMARILY FOR GRADUATE STUDENTS, major or minor, open to qualified undergraduates

**501, 502, 503. GENERAL BIOCHEMISTRY.**  
(3-0) Cr. 3 each. F.W.S.  
Prerequisite: Courses in analytical chemistry, organic chemistry (Chem. 333 or 335) and physical chemistry (Chem. 322, 325 or 484). Concurrent enrollment in physical chemistry may be permitted with consent of instructor.  
Chemical composition of living matter and the chemistry of life processes. Designed 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.**  
(1-0) 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.**  
(1-0) Cr. 3. S.  
Prerequisite: Chem. 426, permission of instructor.  
Aronoff.  
The use of radioisotopes in biochemistry: dilution techniques, isolation of metabolites, elucidation of reaction mechanisms and metabolic pathways.
561, 562. BIOPHYSICAL METHODS.
Cr. 3 each. W.S.  
Prerequisite: Fundamental training in biology, physics, calculus, organic and physical chemistry, permission of instructor. Foss, 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.
(6-0) Cr. 2 each. W.S.  
Prerequisite: Permission of instructor. Foss, Rougvie.
To accompany 561, 562

574. MICROSCOPY.
(3-0) Cr. 3. S.  
Prerequisite: Math. 111, Phys. 113 or 223. Outka, To.
Optical microscopy including phase and interference techniques Principles of electron optics, Methods and applications of electron microscopy.

COURSES FOR GRADUATE STUDENTS, major or minor

601. ADVANCED BIOCHEMISTRY.
(2-0) Cr. 2 each time elected. F.W.S.
Prerequisite: 501, permission of instructor.
A series of one-term courses covering such topics as enzymes, hormones, lipids, nucleic acids, proteins, vitamins, biochemistry of diseases, immunology, and biochemical methods.

622. CARBOHYDRATE CHEMISTRY.
(3-0) Cr. 3. S. French.
Prerequisite: Permission of instructor.
Chemical behavior and enzymic relationship of sugars and polysaccharides.

661. ADVANCED BIOPHYSICS.
(3-0) Cr. 2 each time elected. F.
Prerequisite: Permission of instructor.
Intensive study of selected areas of biophysical research chosen from such topics as molecular genetics, muscle contraction and motility, nerve conduction, vision, hearing, photosynthesis, fine structure of biological systems, radiation biology, new or advanced techniques, and macromolecular physics and chemistry.

680. MODERN VIEWS OF NUTRITION.

681. ADVANCED SEMINAR.
(1-0) Cr. 0. Yr.

695. RESEARCH.
Prerequisite: Permission of staff member concerned.

698. SEMINAR IN CELL BIOLOGY.

BIOLOGY

Advisory Committee: Robert Franke, Ph.D., Chairman; John Dodd, Ph.D.; Jewett Dunham, Ph.D.; John G. Holt, Ph.D.; George Knaphus, Ph.D.; John Mutchmor, 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. Certain biology courses are taught under a cooperative arrangement among these departments and are listed below. In addition, the Departments of Agronomy, Animal Science, Child Development, Dairy and Food Industry, Food and Nutrition, Forestry, Horticulture, Poultry Science, Psychology; departments within the College of Veterinary Medicine; and major programs in biomedical engineering, dairy 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-B, 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. This general education sequence 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 21-credit sequence: Biol. 101, 101A, 103, 106,
Courses and Programs

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 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 degree 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 21 credits of "core" biology, their programs usually include the following basic courses: Bot. 306, 320, 404; Gen. 301; Zool. 224, 234, 355; B. & B. 301 or 401 or 404, 405, 406. 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. 274, 303, 306, 307, 311, 340, 447, 464, 503, 504, 572 or a field biology sequence at Iowa Lakeside Laboratory. Other particularly desirable biology courses for students majoring in biology include: Bact. 330, 340; Bot. 424 or Zool. 402 or 405; Bot. 555 or Zool. 324; Bot. 504 or Zool. 528; Gen. 305, 401, B. & B. 461. Supporting courses usually include one year of physics; chemistry through 335; mathematics through 112 or 162; Stat. 201A and Com. S. 214. Biology majors seeking certification to teach secondary school biology must formally apply to the office of the Dean of the College of Sciences and Humanities for admission to the Teacher Education Program. See Index, College of Education. In addition to the courses expected of all biology majors, such students will take Zool. 274; Psych. 101, 230, 333; Educ. 204, 305A, 305B, 426; D.St. 417D, 486.

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 the individual's 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. SS.
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.
(0-6) Cr. 2. F.W.S. SS.
Prerequisite: Credit or classification in Biol. 101.
Study of the 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 euch. 102A: F.W.SS.; 102B: F.W.S. SS.
Prerequisite: Credit or classification in 101.
Structure vs function, reproduction and evolutionary position of representative organisms. 102A and 102B together constitute a general education 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.
A. Bacteria, Viruses and Plants
B. Animals

103. ENVIRONMENTAL BIOLOGY.
(3-0) Cr. 3. W.
Prerequisite: Biol. 101.
The biology of man's changing environment. Principles of ecology; population dynamics; biogeochemical cycles; misuse of resources; environmental pollution.

106. GENERAL ZOOLOGY.
(Zool. 106) See Zoology.

107. GENERAL BOTANY.
(Bot. 107) See Botany.

300. GENERAL BACTERIOLOGY.
(Bact. 300) See Bacteriology.
BIOMEDICAL ENGINEERING

Neal R. Cholvin, D.V.M., Ph.D., Chairman


Professors: William C. McCormack, M.D.; Phillip T. Pearson, D.V.M., Ph.D.; Donald F. Young, Ph.D.


Assistant Professors: William H. Brockman, Ph.D.; Curran S. Swift, 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 baccalaureate 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

Major work in biomedical engineering is offered for the degrees Master of Science and Doctor of Philosophy. Minor work is offered to 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, it is advisable that the student elect minor work in one of these divisions, examples of which are: veterinary anatomy, biochemistry and biophysics, chemical engineering, electrical engineering, engineering mechanics, mechanical engineering, veterinary physiology, psychology, and zoology. All students are encouraged to obtain previous background knowledge of organic chemistry, calculus, beginning differential equations, and physics.

The program of formal courses taken by students will be oriented toward developing proficiency in research in the interdisciplinary field. Selected background and advanced coursework from other related disciplines will be taken in conjunction with appropriate interdisciplinary 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.
The following interdisciplinary courses are specifically concerned with major graduate work in biomedical engineering: V.Anat. 513; V.Phys. 514, 515, 661; E. E. 441, 445, 447, 571, 572, 671; E. M. 420; Ch. E. 430. Additional biomedical engineering topics are offered occasionally in the above departments as special courses.

In addition, the following courses are recognized to have a strong bearing on studies in biomedical engineering: Ch. E. 631, 632, 633, 554, 555, 556; E. E. 501, 502, 503, 565, 575, 584; E.M. 504, 505, 506, 514, 571, 544, 548; Nuc.E. 684; Math. 521, 522, 523; V.An. 510, 511; V.Phys. 512, 661.

Research topics for thesis requirements at both the Master of Science and Doctor of Philosophy levels may be conducted in laboratory facilities available in the Biomedical Engineering Building.

BOTANY AND PLANT PATHOLOGY

Frederick G. Smith, Ph.D., Head of Department


Associate Professors: Dean C. Foley, Ph.D.; Richard E. Ford, Ph.D.; Robert G. Franke, Ph.D.; James C. Horton, Ph.D.; George Knaphus, Ph.D.; Clifford E. LaMotte, Ph.D.; Roger Q. Landers, Ph.D.; Nels R. Lersten, Ph.D.; Charlie A. Martinson, Ph.D.


Undergraduate Study

For undergraduate curriculum in sciences and humanities, major in botany leading to the degree Bachelor of Science, see College of Sciences and Humanities, Curriculum.

For undergraduate major in plant pathology leading to the degree Bachelor of Science, see College of 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 and 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: Blol. 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, 504, 506, 564. Undergraduate minor programs and supporting courses usually include: B. & B. 301 or 405; Chem. 101, 102, 103, 211, 334, 335; Gen. 301; Geol. 100; Math. 103, 110; Phys. 111, 112, 133; Zool. 224, 274, 355. 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 the individual's needs.
Graduate Study

The department offers major work for the degrees Master of Science and Doctor of Philosophy in cytology, ecology, morphology, mycology, pathology, phycology, physiology, taxonomy, and economic botany, and minor work to students majoring 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. 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. Foreign language training in German, French or Russian is desirable.

Students majoring in botany usually select minors from bacteriology, biochemistry and biophysics, chemistry, agronomy, forestry, genetics, geology, horticulture, physics, or zoology and entomology.

Open to graduate students for minor only: 404, 407, 410, 416, 417, 424, 438.

COURSES PRIMARILY FOR UNDERGRADUATE STUDENTS

107. GENERAL BOTANY.
(Biol. 107) (3-6) Cr. 5. W.S. SSI.
Prerequisite: Biol. 101A.
The relationship of structure and function, development, reproduction and evolutionary relationships of representative plants.

*110. TECHNICAL LECTURE.
(1-0) Cr. R.S.
Required of 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.
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. F.
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.

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. BOTANY OF ECONOMIC PLANTS.
(3-2) C. 4. W.
Prerequisite: 107 or Biol. 102A.
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. SSSI.
Prerequisite: 107.
Principles of classification of seed plants, survey of major plant families, identification and field study of local plants. Field trips. May be taken for seven or eight credits at Iowa Lakeside Laboratory with written permission of instructor.

310. PLANT PHYSIOLOGY.
(3-3) Cr. 4. W. SSI.
Prerequisite: 107, Chem. 102.
Principles of vascular plant function including absorption and translocation of water and solutes, transpiration, photosynthesis, respiration, growth and development, and hormonal regulation. Required for majors and recommended for other students majoring in biological sciences.

320. PLANT PHYSIOLOGY.
(3-6) Cr. 5. S.
Prerequisite: 107, Chem. 334 or B. & B. 301.
Principles of vascular plant function including absorption and translocation of water and solutes, transpiration, photosynthesis, respiration, growth and development, and hormonal regulation. Required for majors and recommended for other students majoring in biological sciences.

338. SEED ANALYSIS.
(1-4) Cr. 3. Alt. W. Offered 1971.
Prerequisite: 216, Agron. 114.
Techniques of seed quality determination. Application to major agronomic and horticultural crops, applications of seed analysis and seed biology to quality control and marketing. Seed control legislation.

399. UNDERGRADUATE SEMINAR.
(1-0) Cr. 1 each time elected. W.
Prerequisite: Junior classification and 12 credits in botany.
Meetings of students and staff to discuss topics of current interest in plant science.
Courses and Programs

404. PLANT ANATOMY.
(2-3) Cr. 4. W. SSII.
Prerequisite: 107.
Structure and development of vegetative and reproductive organs of vascular plants, with emphasis on angiosperms.

*407. PRINCIPLES OF PLANT PATHOLOGY.
(2-4) Cr. 4. W.
Prerequisite: 310 or 320.
Principles underlying the nature and control of plant diseases.

410. FUNDAMENTALS OF BOTANY.
(3-4) Cr. 5. S.
Prerequisite: 15 credits in physical science. Study of plant forms and functions with approximately equal emphasis on morphological-evolutionary and on physico-chemical aspects of botany. Primarily for advanced students with strong backgrounds in the physical sciences.

*416. FOREST PATHOLOGY.
(For. 417) (2-6) Cr. 4. S.
Prerequisite: 310 or 320.
Nature and control of forest and shade tree diseases. Weekend field trips in northern and eastern Iowa.

*417. WOOD DETERIORATION.
(For. 417) (2-6) Cr. 4. W.
Prerequisite: 310 or 320.
Decay and stains of wood, including forest product pathology. Field trips to local woods and lumber yards.

424. GENERAL PLANT ECOLOGY.
(2-3) Cr. 3. F. S. SSII.

COURSES PRIMARILY FOR GRADUATE STUDENTS, major or minor, open to qualified undergraduates

500. ALGOLOGY.
(3-3) Cr. 4. F. (SSI Lakeside Lab.)
Prerequisite: 15 credits in biological science. Dodd.
Identification and morphological study of algae with special reference to the fresh water algae of the midwest. Field trips. May be taken for seven or eight credits at Iowa Lakeside Laboratory with written permission of instructor.

504. PLANT CYTOLOGY.
(3-3) Cr. 4. S.
Prerequisite: 6 credits in biological science. Gen. 301; Chem. 335 recommended. Bowen.
The anatomy and physiology of cytoplasm and nucleus. Cell division and the role of the cell in reproduction.

505. MORPHOLOGY OF GREEN PLANTS.
(3-6) Cr. 5. S.
Prerequisite: 15 credits in biological science including 107. Lersten.
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: 15 credits in biological science. Tanny.
Morphology, cytology and physiology of fungi; their relation to agriculture and industry.

509. GENERAL VIROLOGY.
(see Bact. 509)

511. PLANT NUTRITION.
(3-0) Cr. 3. F.
Prerequisites: 320, Phys. 112, Chem. 335 LaMotte.
Mineral nutrition, water relations and translocation in vascular plants.

512. PLANT GROWTH REGULATION.
(3-0) Cr. 3. W.
Prerequisite: 320 and 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. Stewart.
Photosynthesis, respiration and nitrogen metabolism in plants.

514. PLANT MORPHOGENESIS.
(3-0) Cr. 3. S.
Prerequisite: 404, 512.
Causal mechanisms underlying patterns of development.

517. PHYSIOLOGICAL METHODS AND TECHNIQUES.
(0-6, or 0-9) Cr. 2 or 3. F.W.
Prerequisite: Credit or classification in 511, 512 or 513. Nevins.
Research methods and techniques in plant physiology.

518. ENZYMES IN PLANT METABOLISM.
(3-0) Cr. 3. S.
Prerequisite: Permission of instructor. Smith.
Nature of enzyme action, role of enzymes in metabolism, and methods of investigation.

*541. DISEASES OF ECONOMIC PLANTS.
(3-3) Cr. 4. F.
Prerequisite: 407.
Diseases of economic plants caused by bacteria, fungi, nematodes and viruses. For students not majoring in plant pathology.
555. BOTANICAL MICROTECHNIQUES. (2-9) Cr. 5. F.  
Prerequisite: 310 or 320, 404, and permission of instructor. Horner.  
Methods of studying plant materials with the light microscope; microtomy, photomicrography,  
general and histochemical staining; and other related procedures.

558. PALEOBOTANY. (2-3) Cr. 3. Alt. W. Offered 1970.  
Prerequisite: Permission of instructor. Mickel.  
Introduction to the morphology, relationships, and identification of fossil plants. Field trips  
for their occurrence to aquatic plants, with emphasis on molds and fungi imperfecti, and basidiomycetes.

564. AQUATIC PLANTS. (2-3 or 2-6) Cr. 3 or 4. F.  
Prerequisite: 306. Wooten.  
Taxonomy, ecology and morphological specializations of aquatic plants, with emphasis on  
seven or eight credits at Iowa Lakeside Laboratory with written permission of instructor.

*574. PLANT NEMATOLOGY. (2-3) Cr. 3. F.  
Prerequisite: 407 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. SSII. 1971. (SSII. 1970. Lakeside Lab.)  
Prerequisite: 9 credits in botany. Tiffany.  
Collection and taxonomy of fungi and relation of their occurrence to environmental factors. Preparation and utilization of mycological exsiccati. Field trips. May be taken for seven or eight credits at Iowa Lakeside Laboratory with written permission of instructor.

579. SPECIAL TOPICS. Cr. 2 to 5 each time elected. F.W.S.  
Prerequisite: 15 credits in botany, permission of instructor.

A Morphology Dodd, Horner, Lersten.
B Physiology Burris, LaMotte, Nevins, Smith, Staniforth, Stewart.
D Mycology Franke, Tiffany.
E Taxonomy. Isely, Pohl, Wooten.
F Plant Ecology Landers, Wooten.
G Economic Botany Isely.
H Cytology. Bowen, Horner.

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.

*591. ADVANCED GENERAL PLANT PATHOLOGY. (3-3) Cr. 4. F.  
Prerequisite: 404, 407, 504, 506, 509, 574, 511 or 512 or 513, Bact. 304, Gen. 301, and credit or concurrent registration in Stat. 401.  
A detailed study of representative plant diseases, plant disease concepts and processes, and an intensive literature review. For students majoring in plant pathology.

592. HOST-PARASITE INTERACTIONS. (3-3) Cr. 4. W.  
Prerequisite: 591.  
The study of the physiological and morphological aspects of plant disease.

593. EPIPHYTOLOGY. (3-3) Cr. 4. S.  
Prerequisite: 592, Stat. 402.  
The study of interactions between and among host populations, parasite populations and the environment.

594. PHYTOGEOGRAPHY. (3-6) and two week-end field trips. Cr. 3. F.  
Prerequisite: 15 credits of biological science, including Bot. 306; historical geology recommended. Pohl.  
A discussion of the history and nature of the principal vegetational formations, particularly of North America. Origins of vascular flora of North America; the arcto-tertiary flora; terti­ ary floras of the eastern and western U.S., origins of the grassland and desert floras, Pleistocene and recent floristic history of the North American vegetation.

596. 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 FOR GRADUATE STUDENTS, major or minor **

601. ADVANCED MORPHOLOGY. (2-0) Cr. 2 each time elected. F.W.S.  
Prerequisite: 505.  
Special topics in major plant groups. Reading, discussions, oral and written term papers.

605. CYTOGENETICS. (Gen. 605) See Genetics.

624. PHYSIOLOGY OF FUNGI. (3-0) Cr. 3. Alt. W. Offered 1970.  
Prerequisite: 506. Smith.  
Special physiology of fungi, nutrition, metabolism, growth and toxicology.

641, 642, 643. GENERAL MYCOLOGY. (2-6) Cr. 4 each yr. Yr.  
Prerequisite: 407 or 416 or 417. Tiffany.  
Taxonomy, morphology and phylogeny of slime molds and fungi (phycomyces, ascomycetes, fungi imperfecti, and basidiomycetes).

646. ANIMAL MYCOLOGY. (0-6) Cr. 3. Alt. W. Offered 1970.  
Prerequisite: 506. Tiffany.  
Morphology, cytology, and physiology of fungi causing animal mycoses; includes superficial mycoses, dermatomycoses, and systemic mycoses.

680. LABORATORY IN ELECTRON MICROSCOPY. (2-9) Cr. 5. W.  
Prerequisite: 555 or B. & B. 574 and permission of instructor. Horner.  
Methods of studying plant materials with the electron microscope; ultrastructure, photomicrography; negative-staining; fractionating; freeze-etching; and other related procedures.

690. ADVANCED PLANT TAXONOMY. (2-6) Cr. 4. S.  
Prerequisite: 306. Pohl.  
Principles of plant classification; bibliographic tools of systematic botany; methods of collection, preservation and study of vascular plants.
294 Courses and Programs

• 691. TOPICS IN ADVANCED PLANT PATHOLOGY.
   (2-0) or (0-6) Cr. 2 each time elected.
   Prerequisite: 593.
   F. Clinical Diagnosis. SSI, II.

• 692. SYSTEMATICS OF THE LEGUMES.
   (1-6) Cr. 3. Alt. S. offered 1970.
   Prerequisite: 306. Issely.
   Classification, evolution and identification of legumes. Emphasis on major taxonomic groups and those of economic significance.

• 695. RESEARCH.
   A. Morphology Dodd, Horner, Lersten.
   B. Physiology Burris, LaMotte, Nevins, Smith, Stanforth, Stewart.
   *C. Plant Pathology Browning, Dunleavy, Foley, Ford, Horton, McNabb, Martinson, Norton, Simons, Tiffany, Wallin.
   D. Mycology Franke, Tiffany.
   E. Taxonomy Issely, Pohl, Wooten.
   F. Plant Ecology Landers, Wooten.
   G. Economic Botany Issely.
   J. Cytology Bowen, Horner.

698. SEMINAR.
Meetings of botanical staff and students to discuss recent literature and problems under investigation.
   A. Cr. 1. F.S.
   For students taking major work in morphology and taxonomy
   B. Cr. 1. F.S.
   For students taking major work in physiology and ecology
   *C. Cr. 1. F.S.
   For students taking major work in plant pathology.
   D. Cr. 1. W.
   For all staff and students in Botany and Plant Pathology
   E. Cell biology S (Zool 698 B & B 698, Bact 698, Gen 698) See Zoology

*Administered by the College of Agriculture. Courses not marked by an asterisk are administered by the College of Sciences and Humanities

BUILDING CONSTRUCTION

Thomas C. Jellinger, M.S., Professor in Charge

Instructors: Donald E. Kawal, M.S.; Norman Riis, B.S.

Undergraduate Study

The Department of Civil Engineering provides a curriculum for those students who are interested in building construction. 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 building construction offers much of the background that contractors need. It blends engineering, architecture, management and business administration to achieve this.

For listing of curriculum by quarters, see Index.

Graduate Study

The Building Construction curriculum includes the following courses, open to graduate students for minor graduate credit only: 355, 371, 372, 441, 442, 450, 480.

COURSES PRIMARILY FOR UNDERGRADUATE STUDENTS

100. TECHNICAL LECTURE.
   (1-0) Cr. R. S.
   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.
   Prerequisite: Second year classification or approval of the Professor in charge of Building Construction.
   Systems of building construction including wood frame, wall bearing, skeleton frame, and the building materials used in these systems

245. SPECIFICATIONS.
   (2-0) Cr. 2. W.
   Prerequisite: 241 or Arch. 343.
   Preparation and interpretation of architectural specifications and other contract documents.
246. CONSTRUCTION COST ESTIMATING. 
(2-3) Cr. 3. S. 
Prerequisite: 245. 
Estimating building construction costs, quantity surveys, production rates, local cost factors. Approximate and detailed methods.

355. REAL ESTATE FINANCE. 
(1 Ad. 355) See Industrial Administration.

371. BUILDING CONTRACTORS ORGANIZATION. 
(3-0) Cr. 3. W. 
Prerequisite: 246. 
Construction contracting business management: planning, organization, staffing, directing, controlling.

372. CONSTRUCTION PLANNING AND PROGRESS SCHEDULING I. 
(0-9) Cr. 3. 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. 
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. 201 B. 
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.

480. SPECIAL PROBLEMS IN BUILDING CONSTRUCTION. 
Cr. 2 to 5 each time taken. 
Prerequisite: 372. Permission of Professor in charge of Building Construction. 
Advanced problems in building construction with emphasis in the field of construction operations and in the field of engineering and technology.

CELL BIOLOGY
C. C. Bowen, Ph.D., Chairman

Undergraduate Study
A special curriculum in cell biology is not offered for the baccalaureate degree. 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. Bot. 504 or Zool. 528 and B.&B. 578 are recommended to qualified undergraduates desiring an introduction to this area.

Graduate Study
Major work in cell biology is offered for the degrees Master of Science and Doctor of Philosophy 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.

CERAMIC ENGINEERING
David R. Wilder, Ph.D., Head of Department

Professors: Charles M. Dodd, Cer.E.; Thomas D. McGee, 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 non-metallic 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.

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 major work leading to the degrees Master of Science and Doctor of Philosophy in ceramic engineering and minor work to students taking major work in other departments. Minor work will be selected in related fields.

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.

For the degree Doctor of Philosophy the foreign language requirement may be met in one of the following three ways:

a. A score of at least 400 in each of two Educational Testing Service foreign language examinations (French, German or Russian);

b. A score of at least 600 in one Educational Testing Service foreign language examination (French, German or Russian);

c. 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. 102A, 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: 233. 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.
Theory of vitreous state in ceramic glasses. Glass forming reactions. Relationship of properties to composition and processing.
343. ELECTRONIC CERAMICS.
(3-0) Cr. 3. S.
Prerequisite: 221, Chem. 323, credit or classification in E.E. 445.
Relation of composition, crystal structure and fabrication techniques to the electrical and magnetic properties of ceramic materials.

347. CERAMIC CONSTRUCTION MATERIALS.
(Arch. 347) (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.
Prerequisites: 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.

COURSES PRIMARILY FOR GRADUATE STUDENTS, major or minor, open to qualified undergraduates

512. CERAMIC TECHNOLOGY.
(3-0) Cr. 3.
Prerequisite: Permission of instructor.

513. CERAMIC TECHNOLOGY.
(3-0) Cr. 3.
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.
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.
Prerequisite: Major in ceramic engineering. Thermodynamics of point defects in ceramic crystals. Control of point defect concentration by stoichiometry, doping, and atmosphere.

532. THEORY AND PROPERTIES OF COLLOIDAL AND RELATED CERAMIC MATERIALS.
(3-0) Cr. 4.
Prerequisite: Permission of instructor.
Fundamentals of colloidal phenomena as applied to ceramic systems, including theory of deflocculation, rheology and measurements.

550. 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.
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.
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.
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.
Prerequisite: 618 or permission of instructor. Phase equilibria of the ceramic and closely related systems.

690. **RESEARCH.**

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**CHEMICAL ENGINEERING**

George Burnet, Jr., Ph.D., Head of Department

*Professors:* William H. Abraham, Ph.D.; Lionel K. Arnold, Ph.D.; David R. Boylan, Ph.D.; Lawrence E. Burkhart, Ph.D.; Maurice A. Larson, Ph.D.; Morton Smutz, Ph.D.; Thomas D. Wheelock, Ph.D.

*Associate Professors:* Edgar V. Collins, M.S.; Allen H. Pulifer, Ph.D.; Richard C. Seagrave, Ph.D.; John B. Sheeler, Ph.D.; Frank O. Shuck, Ph.D.; John D. Stevens, Ph.D.; F. Dee Stevenson, Ph.D.; George T. Tsao, Ph.D.

*Assistant Professors:* Anthony L. Frey, Ph.D.; Albert C. Miller, B.S.; Robert W. Shearer, B.S.

*Instructors:* Joseph B. Fernandes, Ph.D.; Wayne J. Genck, M.E.; William M. Swift, M.S.

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**Undergraduate Study**

For undergraduate curricula 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 the 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 and/or on systems used for processing matter and information.

A five-year cooperative work-study program is available in the Chemical Engineering Department. See *College of Engineering, Cooperative Programs.*

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**Graduate Study**

The department offers major work for the degrees Master of Science, Master of Engineering and Doctor of Philosophy 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.

Minor work usually will be selected from chemistry, mechanical engineering, mathematics, physics, statistics or nuclear science.
There is no foreign language requirement for the degrees Master of Engineering or Master of Science.

For the degree Doctor of Philosophy a student must demonstrate a satisfactory reading knowledge of one of the following languages: 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.

Open to graduate students for minor credit only: 351, 352, 353, 411, 430, 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 laboratorian on special problems.

201. INTRODUCTION TO CHEMICAL ENGINEERING.
(3-0) Cr. 3. F.
Prerequisite: Credit or classification in Chem. 103. 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 newer processes to provide an overall 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. 103, Math. 213, Phys. 222. Material and energy balances, fluid flow, heat and mass transfer, rate processes, stagewise 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.
(1-3) Cr. 2. 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 stage 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.

411. CHEMICAL PROCESS INDUSTRIES.
(3-0) Cr. 3. W.
Prerequisite: Credit or classification in Chem. 334. Detailed studies of the history, raw materials, manufacturing methods, economics and chemistry of industrial chemical processes; coordination of unit operations and processes employed.

430. BIOMEDICAL APPLICATIONS OF HEAT AND MASS TRANSFER.
(3-0) Cr. 3. W.
Prerequisite: E.M. 420, V.An. 513. 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.

435. PROCESS CONTROL.
(4-0) Cr. 4. 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 dynamics 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. F.W.
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. F.
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 gas-liquid absorption, simultaneous heat and mass transfer, and chemical reactor technology are discussed.

461, 462. CHEMICAL ENGINEERING THERMODYNAMICS.
(3-0 and 2-0) Cr. 3, 2. F.W.
Prerequisites: 461: Math. 112, Phys. 222; 462: 461, and 341 or Com.S. 214.

COURSES PRIMARILY FOR GRADUATE STUDENTS, major or minor, open to qualified undergraduates

500. INDIVIDUAL PROBLEMS.
Prerequisite: Major in chemical engineering.
Investigation of an approved topic on an individual basis.

504. PLASTICS TECHNOLOGY.
(3-0) Cr. 3. S.
Prerequisite: Chem. 335.
Chemistry and technology of plastic resins, production and use of finished plastic products.

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.

535. PROCESS DYNAMICS.
(3-0) Cr. 3. S.
Prerequisite: 435.
Applications of dynamic analysis techniques in the study of non-steady state chemical processes.

541, 542. CALCULATION METHODS FOR CHEMICAL ENGINEERS.
(3-0) Cr. 3 each. F.W.
Prerequisite: 541: 454, credit or classification in Math. 322; 542: 541.
541: Analysis and design of equipment and processes and the solution of the resulting differential equations by operational, series and analog computer techniques. 542: Advanced analysis and design of equipment and processes by digital computer simulation and solution.

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 catalytic flow and batch reactors.

465, 466, 467. SPECIAL PROBLEMS.
(0-3 to 18) Cr. 1 to 6 each. Yr.
Introduction to research methods; investigation of an approved topic
H Honors Students.

471, 472, 473. CHEMICAL ENGINEERING DESIGN.
(1-6) Cr. 3 each. Yr.
Prerequisite: 471: Credit or classification in 454, 461; 472: 471 and credit or classification in 462; 473: 472 and credit or classification in 463.
Principles of process and plant design; economic and feasibility analysis; application of optimization techniques.

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.

554, 555, 556. ADVANCED UNIT OPERATIONS.
(3-0) Cr. 3 each. Yr.
Prerequisite: 454.
554: 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 fluidization; flow past submerged bodies. 555: Energy transport processes. Steady-state and dynamic thermal processes, coupled energy and momentum transfer, and radiative transport. 556: Mass transfer. Diffusion theory, two phase mass transfer, mass transfer efficiencies, coupled heat and mass transfer.

565. MULTI-STAGE OPERATIONS.
(3-0) Cr. 3. SS.
Prerequisite: 351.
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: 351.
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 non-ideal fluids.

582. THERMODYNAMICS OF MULTI-COMPONENT SYSTEMS.
(3-0) Cr. 3. W.
Prerequisite: 581.
Thermodynamic properties of solutions. Phase equilibria and chemical reaction equilibria.

585. 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.

599. SPECIAL TOPICS.
Cr. 2 to 5 each time elected. F.W.S.
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 electro-chemistry and bioengineering.

COURSES FOR GRADUATE STUDENTS, major or minor

600. CHEMICAL ENGINEERING RESEARCH.
601, 602, 603. SEMINAR.
(1-0) Cr. 1 each. Yr.
631, 632, 633. ADVANCED TRANSPORT PHENOMENA.
(3-0) Cr. 3 each. Alt. Yr.
Prerequisite: 556, Math. 322, 410.
Advanced topics in the transport of momentum, energy and mass; derivation and application of equations of change; thermodynamics of irreversible processes; statistical theories of turbulence; eddy diffusion; boundary layer theory; particulate systems (packed and fluidized beds); non-Newtonian systems; correlation of transfer coefficients.

643. ADVANCED CALCULATION METHODS FOR CHEMICAL ENGINEERS.
(3-0) Cr. 3. S.
Prerequisite: 541.
Advanced analysis and design of equipment and processes requiring specialized mathematical techniques.

CHEMISTRY

John D. Corbett, Ph.D., Chairman of Department


Assistant Professors: Hugo F. Franzen, Ph.D.; David K. Hoffman, Ph.D.; Roy W. King, Ph.D.; Thomas H. Kinstle, Ph.D.; Walter S. Trahanovsky, Ph.D.

Instructors: Thomas J. Barton, Ph.D.; G. Vincent Calder, Ph.D.; Jon Clardy, Ph.D.; Dennis C. Johnson, Ph.D.; Gerald A. Pearson, Ph.D.; Charles J. V. Scanio, 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 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, non-specialized study which may be needed.

Graduate Study

The department offers major work for the degrees Master of Science and Doctor of Philosophy in inorganic, analytical, physical, organic chemistry and combinations and specializations within these general areas. 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 graduate credit only: 301, 302, 320, 321, 322, 323, 334, 335, 336, 408, 426, 483, 484.

Index to field of work is given by the second and third figures of course numbers:

(a) Systematic Inorganic Chemistry 00 to 09
(b) Analytical Chemistry 10 to 19
(c) Physical Chemistry 20 to 29
(d) Organic Chemistry 30 to 39
(e) Open 40 to 59
(f) Household (including Textile) Chemistry 60 to 69
(g) Open 70 to 79
(h) Physical Chemistry 80 to 89
(i) Research 90 to 99

For courses in biochemistry, biophysics and metallurgy, see Index.

COURSES PRIMARILY FOR UNDERGRADUATE STUDENTS

101, 102, 103. GENERAL CHEMISTRY.
(3-4) Cr. each. 101: F.W.SS.; 102, 103: W.S.SS.
Principles of chemistry, properties of matter presented and explained in terms of modern chemical theory. Only students who have not had high school chemistry will be classified in 101 during the fall quarter. 101 is not acceptable for credit toward graduation for students majoring in chemistry.

101A, 102A. GENERAL CHEMISTRY.
(3-4) Cr. 4 each.
Students with one unit of high school chemistry will be classified in either 101A or 102A during fall quarter; classification in 102A is based on high school rank and test scores. 102A provides a recognition in the form of college credit for high school training in chemistry. Students who pass 102A will receive credit in both 101A and 102A. Students wanting an additional course in general chemistry normally will take 103. 101A is not acceptable for credit toward graduation for students majoring in chemistry.

107, 108. PRINCIPLES OF MODERN CHEMISTRY.
(3-4) Cr. 4 each. F.W.
Prerequisite: High school chemistry and physics with grades of B or better, top 20 percent of high school class, classification in Math. 110. Principles of chemistry explored at greater depth than in Chem 102A, 103. May be elected by well-prepared students in all colleges who meet the prerequisites and desire a more rigorous course. Students completing 107 will receive credit for 101A.

114. QUANTITATIVE ANALYSIS.
(3-6) Cr. 5. F. S.
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. Only 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 non-metallic compounds. For chemistry majors.

211. QUANTITATIVE ANALYSIS.
(3-6) Cr. 5. F. W. S. SS.
Prerequisite: 103
A one-quarter course in theory and practice of elementary gravimetric, volumetric, and colorimetric analysis.

224. PHYSICAL CHEMISTRY.
(3-0) Cr. 3. S.
Prerequisite: 114, Math. 112, Phys. 112 or 222.
Elementary thermodynamics and theory of the gaseous state. Homogeneous equilibria. Only for students majoring in chemistry, chemical engineering, or biochemistry.

231. ELEMENTARY ORGANIC CHEMISTRY.
(3-3 or 6) Cr. 4 or 5. F.W.S.S.
Prerequisite: 102
Fundamentals of organic chemistry for students in home economics or agriculture. Agriculture students will automatically elect this course for five credits. Home economics students automatically will elect for four credits.

301. 302. INORGANIC CHEMISTRY.
(3-0) Cr. 3 each. 301; W; 302: S.
Prerequisite: 325 or 322
The nature of 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.
(6-6) Cr. 2. S.
To accompany 302. Only for students majoring in chemistry or biochemistry.

309. INORGANIC CHEMISTRY REVIEW.
(3-0) Cr. 3. F.
Prerequisite: Permission of instructor
A review of advanced, undergraduate inorganic chemistry and the reactions of the ions in qualitative analysis. Designed especially for students who wish to prepare for graduate courses in inorganic chemistry.

315. QUANTITATIVE ANALYSIS.
(3-6) Cr. 5. S.
Prerequisite: 115, 326.

319. ANALYTICAL CHEMISTRY REVIEW.
(3-0) Cr. 3. F.
Prerequisite: Permission of instructor
A review of undergraduate quantitative analysis. Designed for students who have already completed at least two quarters of analytical courses and who wish to review in preparation for graduate courses.

320. LABORATORY IN PHYSICAL CHEMISTRY.
(3-0) Cr. 1. W.
Prerequisite: Credit or classification in 322.
To accompany 321, 322, 323.

321, 322, 323. PHYSICAL CHEMISTRY.
(3-0) Cr. 3 each. 321: F. S.; 322: F.W.; 323: W.S.
Prerequisite: 321: 211 or 114, Phys. 223, Math. 112 preferred; 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 ordinarily will elect 224, 325, 326, 327.

325. PHYSICAL CHEMISTRY.
(3-0) Cr. 3. F.
Prerequisite: 224. Heterogeneous equilibria. Electrochemistry. Only for students majoring in chemistry, chemical engineering, or biochemistry.

326. PHYSICAL CHEMISTRY.
(3-0) Cr. 3. W.
Prerequisite: 325.

327A, 327B. EXPERIMENTAL PHYSICAL CHEMISTRY.
(0-6) Cr. 3 each. 327A: F; 327B: W.S.
Prerequisite: 327A: 215, 327B: 320A or 327A.
To accompany 325 and 326. Only for students majoring in chemistry, chemical engineering, or biochemistry.

329. PHYSICAL CHEMISTRY REVIEW.
(3-0) Cr. 3. W.
Prerequisite: Permission of instructor.
A review of the principles and applications of physical chemistry. Designed especially for students who have completed a year of undergraduate physical chemistry and who wish to review before attempting 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. Only for students majoring in chemistry or biochemistry.

331. 332, 333. ORGANIC CHEMISTRY.
(3-0) Cr. 3 each. Yr.
Prerequisite: 114.
331, 332: Chemistry of aliphatic and aromatic compounds. Polyfunctional and heterocyclic chemistry. Only for students majoring in chemistry and biochemistry. 333: Modern research techniques and their use in organic chemistry. Only for students majoring in chemistry and biochemistry.

334. 335, 336. ORGANIC CHEMISTRY.
(3-0) Cr. 3 each. 334: F. W.; 335: W.S.; 336: S.
Prerequisite: 103.
Introduction and development of modern organic chemistry, including nomenclature, synthesis, structure and bonding, reaction mechanisms, physical methods, carbohydrates, proteins and lipids. Students majoring in chemistry will or
337. LABORATORY IN ORGANIC CHEMISTRY. (0-6) Cr. 2. W. S.
Prerequisite: Credit or classification in 335.

338. LABORATORY IN ORGANIC CHEMISTRY. (0-3) Cr. 1. S.
Prerequisite: Credit or classification in 336.

339. ORGANIC CHEMISTRY REVIEW. (3-0) Cr. 3. W.
Prerequisite: Permission of instructor.
A review of undergraduate organic chemistry designed especially for students who have completed a year of organic chemistry and wish to review before attempting graduate courses in organic chemistry.

381. CHEMISTRY OF ENGINEERING MATERIALS. (4-0) Cr. 4. S.
Prerequisite: 103, and M. E. 321 or equivalent. Organic materials such as fuels, r-irrigenters, lubriecants and plastics, phase equilibria and the free energy concept. Equilibrium constants for gas systems, kinetics of gas phase reactions, crystal structure. Not accepted for credit in science curriculum.

395. SPECIAL TOPICS IN CHEMISTRY. Cr. var. F. W. S. S.
Prerequisite: Permission of staff member with whom the student proposes to work.
A Modern Chemistry
Cr. Arr. F. W. S. S.

COURSES PRIMARILY FOR GRADUATE STUDENTS, major or minor, open to qualified undergraduates

501. INORGANIC PREPARATIONS. (0-6 or more) Cr. 2 or more each time elected.
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. McCarey, Martin. Theoretical approach for the systematization of inorganic chemistry.

506. 507. SYSTEMATIC INORGANIC CHEMISTRY. (3-0) Cr. 3 each. 506: W. 507: S.
Prerequisite: 505. Angelici, Espenson, Verkade.
506: Non-metallic elements 507: Metallic elements

511. ADVANCED QUANTITATIVE ANALYSIS. (3-0) Cr. 3. F. S.
Prerequisite: 316, 323 or 326, 333 or 336. Banks, Diehl, Fassel, Fritz, Goetz. Emphasis on general methods, descriptive in organic analysis and current literature.

512. ELECTROCHEMICAL METHODS OF ANALYSIS. (2-3) Cr. 3. F.
Prerequisite: 316, 323 or 326, 333 or 336. Banks, Diehl, Fassel, Fritz, Goetz.
Principles and applications of electrochemical methods and mass spectrometry.

513. MOLECULAR ABSORPTION SPECTROPHOTOMETRY. (2-3) Cr. 3. W.
Prerequisite: 316, 323 or 326, 333 or 336.

408. RADIOCHEMISTRY. (2-6) Cr. 4. F.
Prerequisite: Credit or classification in 335. For students in engineering. Fundamental principles of radioactivity, theory, operation and uses of radiation measuring instruments; principles of radiochemistry.

426. RADIONUCLEAR METHODS. (2-0) Cr. 2. F.
Prerequisite: 323 or 326 or 483. Phys. 112. Introduction to the fundamentals of radioisotope techniques and their applications to problems in biology and allied sciences.

483. 484. BIOPHYSICAL CHEMISTRY. (3-0) Cr. 3 each. F. W.
Prerequisite: Math. 112. Chem 320 may be elected concurrently by those desiring laboratory introduction to the fundamentals of physical chemistry with application to biological systems. Not accepted for credit toward a degree in chemistry or chemical engineering.

495. SENIOR THESIS 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. Only for students majoring in chemistry.
521, 522, 523. CHEMICAL THERMODYNAMICS.
(2-0) Cr. 2 each. Yr.
Prerequisite: 323 or 326.
Advanced discussion of the principles of classical thermodynamics

524. SURFACE CHEMISTRY.
(3-0) Cr. 3. Alt. W. Offered 1971.
Prerequisite: 323 or 326. Hansen.
Basic principles and applications.

526, 527. RADIOCHEMISTRY.
(2-0) Cr. 2 each. Alt. W. S. Offered 1970.
Prerequisite: 323 or 326. Martin, Voigt.

528. CHEMICAL KINETICS AND MECHANISMS.
(3-0) Cr. 3, S.
Prerequisite: 323 or 326.
Methods of studying reaction rates and mechanisms; inference of mechanisms from rate laws, reversible, consecutive, and competing reactions, chain mechanisms, exchange reactions, isotope rate effects, very rapid reactions, acid-base catalysis; theories of unimolecular reactions; absolute rate theory.

529. LABORATORY IN RADIOTRACER TECHNIQUES.
(0-6) Cr. 2, W. S.
Prerequisite: 426. Voigt.
Training in measuring radioactive substances and their handling through chemical and biological experiments.

531. 532. MECHANISTIC THEORY OF ORGANIC CHEMISTRY.
(3-0) Cr. 3 each. 531: W; 532: S.
Prerequisite: 323 or 326, 333 or 336. Chapman, Russell.
Organic reaction mechanisms, organic synthesis, stereochemistry of organic processes.

535. ADVANCED ORGANIC LABORATORY.
(0-3 or more) Cr. 1 or more each time elected. F. W. S. Ss.
Prerequisite: Permission of staff member with whom work is to be done. Introduction to experimental techniques in organic chemistry.

536. INTRODUCTION TO ORGANIC CHEMISTRY RESEARCH.
(2-3) Cr. 3. F.
Prerequisite: 323 or 326; 333 or 336.
Principles of infrared, ultraviolet, nuclear magnetic resonance and electron spin resonance spectroscopy as applied to organic chemistry. Physical methods of purification, separation and characterization of organic materials.

539. ADVANCED ORGANIC CHEMISTRY.
(3-0) Cr. 3. F. Ss.
Prerequisite: 323 or 326, 333 or 336.
Advanced descriptive organic chemistry with emphasis on synthesis and stereochemistry.

581, 582. INTRODUCTION TO MOLECULAR STRUCTURE.
581: (3-0) Cr. 3. F; 582: (2-0) Cr. 2. S.
Prerequisite: 581: 323 or 336; 582: 581.
581: Introduction to wave mechanics, electronic states of atoms and molecules, directed valence, polyatomic molecules. 582: Time dependent wave equation, molecular spectroscopy, experimental molecular structure, recent developments in structural research.

COURSES FOR GRADUATE STUDENTS, major or minor

600. SEMINAR IN INORGANIC CHEMISTRY.
(1-0) Cr. 1 each time elected. F. W. S.
Prerequisite: Permission of Instructor. Inorganic staff.

601. SELECTED TOPICS IN INORGANIC CHEMISTRY.
(2-0) or 3-0) Cr. 2 or 3 each time elected. F. W. S.
Prerequisite: 302 or equivalent. Inorganic staff.
A series of one-term courses covering topics such as chemical applications of group theory, molecular structure and bonding, organometallic compounds, physical techniques of structure determination, non-aqueous solvents, reaction mechanisms, and ligand field theory.

611. SEMINAR IN ANALYTICAL CHEMISTRY.
(1-0) Cr. 1 each time elected. F. W. S.
Prerequisite: Permission of Instructor. Banks, Diehl, Fassel, Fritz, Goetz.

620. SEMINAR IN PHYSICAL CHEMISTRY.
(1-0) Cr. 1 each time elected. F. W. S. Ss.
Prerequisite: Permission of Instructor.

621. STATISTICAL THERMODYNAMICS.
(3-0) Cr. 3. each time taken. Alt. F. W. S. Offered 1969-1970.
Prerequisite: Permission of Instructor.
Review of classical and quantum mechanics, principles of statistical mechanics, applications to thermodynamics and other related problems.

622. QUANTUM CHEMISTRY.
(3-0) Cr. 3 each time taken. Alt. F. W. S. Offered 1970-1971.
Prerequisite: Permission of Instructor.
Discussion of the Schrodinger equation, solution in simple cases, perturbation and variation methods. Slater's treatment of complex atoms and molecules, valence bond and molecular orbital methods; applications.

625. SPECIAL TOPICS IN PHYSICAL CHEMISTRY.
(0-2) Cr. 2 each time elected. F. W. S.
Prerequisite: 581 or 582.
A series of one-term courses chosen from such topics as atomic, molecular and nuclear structure, surface chemistry, photochemistry, chemical kinetics, electrochemistry, phase rule.

626. X-RAY CRYSTAL STRUCTURE.
(2-0) Cr. 2 each time taken. F. W. S. Offered on request. Must be started in fall.
Prerequisite: Permission of Instructor.
Lattice and symmetry properties of crystals, diffraction of X-rays by crystals, intensities of diffracted beams, applications of Fourier methods; examples of structures deduced from X-ray investigations.

631. SEMINAR IN ORGANIC CHEMISTRY.
(1-0) Cr. 1 each time elected. F. W. S. Ss.
Prerequisite: Permission of Instructor.
Courses and Programs

632. SPECIAL TOPICS IN ORGANIC CHEMISTRY.
(2-0) Cr. 2 each time elected; F. W. S. SS.
Prerequisite: 532.
Selected topics of current interest in organic chemistry including electron spin resonance spectroscopy, nuclear magnetic resonance spectroscopy, mass spectroscopy, physical organic chemistry, photochemistry, natural products, organometallic chemistry, computer techniques, modern synthetic methods, mechanisms of reductions and oxidations, carbenes, molecular orbital theory, heterocycles, free radicals and kinetics.

695. RESEARCH.
Prerequisite: Permission of staff member concerned.

CHILD DEVELOPMENT
Roger W. Coulson, Ph.D., Head of Department

Professor: Damaris Pease, Ph.D.

Assistant Professors: Aaron G. Auerbach, Ph.D.; Bess-Gene Holt, Ph.D.; Alice F. Lillie, M.S.; Kathryn Madera, M.S.; Russ A. Mahan, M.S.; Edythe Ray, M.S.

Instructors: Samuel G. Clark, M.S.; Irma Galejs, M.S.; Marge Hopper, M.S.; Dorothy Hutchins, M.S.; Ruth Jones, M.S.; Shirley C. Karas, M.S.; Claudette Lee, M.S.; Gilma Olson, M.S.; Marcia Rosenbusch, M.S.; Patricia A. Storck, M.S.; Carol R. Tilford, M.S.

Undergraduate Study

For undergraduate curriculum in child development leading to the degree Bachelor of Science, see Home Economics, Curricula.

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, pre-school, and school-age children are offered.

The student majoring in Child Development may select one of three options: (1) nursery school-kindergarten education (2) community services for children (3) pregraduate study. Students may enroll in the nursery school-kindergarten option as sophomores but must apply to and be accepted by the departmental committee on selection.

For further information for students wishing to combine preparation for work in journalism or radio and television with this curriculum see Home Economics, Home Economics Journalism and Telecommunicative Arts.

Graduate Study

The department offers major work for the degrees Master of Science and Doctor of Philosophy 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.

The foreign language requirement for the degree Master of Science may be waived upon recommendation of the committee in charge of the student's program of study.

Open to graduate students for minor credit only: 434, 460, 461, 500.
COURSES PRIMARILY FOR UNDERGRADUATE STUDENTS

236. PRINCIPLES OF CHILD DEVELOPMENT.
(3-2) Cr. 3. F.W.S.SSI.
Prerequisite: Psych. 101.
Principles of development and guidance of children. Observation in the nursery school

240. LITERATURE FOR CHILDREN.
(4-0) Cr. 4. F.W.S.SSI.
Prerequisite: 236.
Books, stories, poetry and verse for children

336. DEVELOPMENT IN EARLY CHILDHOOD.
(3-2) Cr. 4. F.W.S.
Prerequisite: 236, Psych. 230.
Application of principles of development to children ages 2-6 years. Observation in the nursery school and kindergarten

337. DEVELOPMENT AND GUIDANCE IN LATER CHILDHOOD.
(2-3) Cr. 3. F.W.S.SSI.
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.SSI.
Prerequisite: 336, 337, reservation required.
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

434. DEVELOPMENT IN INFANCY.
(2-2) Cr. 3. F.
Prerequisite: 9 credits in child development and psychology.
Developmental characteristics during the first two years of life

460. GUIDANCE OF CHILDREN.
(3-2) Cr. 4. F.W.S.SSI.
Prerequisite: 366 or El. Ed. 344. Reservation required.
Principles of guidance applied to children in group situations. Observation of adult-child interaction

461. CURRICULUM PLANNING FOR THE YOUNG CHILD.
(2-0) Cr. 2. F.W.S.
Prerequisite: 460.
Principles and techniques of planning a curriculum for a group 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.SSI.
Prerequisite: 461. Classification in 467B, 481, 482, cumulative grade point average of 2.3. 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.SSI.
Prerequisite: Classification in 467A, 481, 482. Reservation required.
Planning and participating in home-school relations programs

467E. SUPERVISED TEACHING IN CHILD CENTERS.
(0-24) Cr. 8. F.W.S.SSI.
Prerequisite: 461, cumulative grade point average of 2.3 reservation required.
Experience in teaching in a children's center for half a quarter

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.
(0-18) Cr. 6. F.W.S.SSI.
Prerequisite: 461. Cumulative grade point average of 2.0. Classification in 470B. 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.SSI.
Prerequisite: Classification in 470A. Reservation required.
Effect of adult-child relationships on development of children in a variety of community services

481. GROUP WORK WITH CHILDREN I.
(0-18) Cr. 6. F.W.S.SSI.
Prerequisite: 460, classification in 470A, 470B. 482 and cumulative grade point average of 2.0. Reservation required.
Supervised work with children of various ages in groups and on an individual basis

482. GROUP WORK WITH CHILDREN II.
(0-6) Cr. 2. F.W.S.SSI.
Prerequisite: Classification in 470A, 470B, 481. Reservation required.
Observation, interpretation, evaluation of work with children. Preparation and presentation of a paper on a child or topic related to 481 placement

490. SPECIAL PROBLEMS.
Cr. Arr. F.W.S.SSI.ISI.
Prerequisite: 12 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. W.
Prerequisite: Credit or classification in Stat. 401 or Educ. 552.
Use of observation, interview, questionnaire, sociometric and rating techniques in child development research, preparation of instruments and methods of data analysis

520. RESEARCH DESIGN IN CHILD DEVELOPMENT.
(3-0) Cr. 3. S.
Prerequisite: 519.
Methods of experimental research with children, research designs in child development

536. PRINCIPLES OF GROWTH AND DEVELOPMENT.
(3-0) Cr. 3. F. SS.
Prerequisite: 536, 537.
Analysis of the developmental approach to the study of child behavior. Emphasis upon principles of development. Laboratory observation

537. THEORIES OF CHILD DEVELOPMENT.
(3-0) Cr. 3. F. W.
Prerequisite: 536.
Theoretical foundations of child development. Examination of major theories and the supporting research evidence

538. INFANT GROWTH AND BEHAVIOR.
(2-2) Cr. 3. F.
Prerequisite: 536, Zool. 358.
Advanced study of infant behavior and development, current research with infants

540. IDENTIFICATION AND REMEDIATION OF LEARNING DISABILITIES.
(3-0) Cr. 3. F.SSI.
Prerequisite: 9 credits in psychology, including educational psychology.
Diagnostic procedures for identification, techniques and materials for treatment of learning disabilities

542. THE DISADVANTAGED CHILD.
(3-0) Cr. 3. S. SSII.
Prerequisite: 3 credits in educational psychology.
Identification and analysis of problems. Implications for the educative process

572. PARENT EDUCATION.
(3-0) Cr. 3. F.
Prerequisite: 336, 337, 3 credits in family relationships.
Principles and procedures of instruction and evaluation in parent education

580. THEORIES AND PRACTICES IN THE EDUCATION OF THE YOUNG CHILD.
(2-3) Cr. 3. F.
Prerequisite: 460.
Theories, objectives and recent research used in nursery education, role of nursery education in the total educational system; observation of a variety of programs for young children

590. SPECIAL TOPICS.
Cr. 1-4 each time elected. F.W.S.SSI, SSII.
Prerequisite: 12 credits in child development, permission of department head.
A Child Development
B Nursery Education
C Community Services

COURSES FOR GRADUATE STUDENTS, major or minor

600. HISTORY AND PHILOSOPHY OF CHILD DEVELOPMENT.
(3-0) Cr. 3. W.SSI.
Prerequisite: Permission of department head.
History of child development, research centers, theories of early childhood education

620. DEVELOPMENTAL APPRAISAL OF THE CHILD.
(3-0) Cr. 3. S.
Prerequisite: Psych. 440.
Analysis of methods in the clinical and experimental appraisal of children.

630. DEVELOPMENTAL PROCESSES IN CHILDREN: PHYSICAL AND MOTOR.
(2-0) Cr. 2. Alt. S. Offered 1970.
Prerequisite: 536, 537.
Theories and concepts of growth, maturation and motor coordination as related to personal and social development

631. DEVELOPMENTAL PROCESSES IN CHILDREN: COGNITION.
(2-0) Cr. 2. Alt. W. Offered 1971.
Prerequisite: 536, 537.
Analysis of cognitive development in children

632. DEVELOPMENTAL PROCESSES IN CHILDREN: PERSONALITY.
(4-0) Cr. 4. Alt. W. Offered 1970.
Prerequisite: 536, 537.
Analysis of personality formation in children.
CIVIL ENGINEERING

Carl E. Ekberg, Jr., Ph.D., Head of Department


Assistant Professors: Merwin D. Dougal, M.S.; Hotten A. Elleby, Ph.D.; Sheldon Kelman, Ph.D.; F. Wayne Klaiber, Ph.D.; Dah-yinn Lee, Ph.D.; Robert A. Lohnes, Ph.D.; Stanley L. Ring, M.S.; James C. Young, Ph.D.

Instructors: Eldon G. Ferguson, M.S.; Robert L. Johnson, M.S.; Donald E. Kawal, M.S.; Derwin C. Merrill, M.S.; Richard E. Montag, M.S.; Reinhold M. Schuster, M.S.; Harris F. Seidel, Ph.D.

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. The facilities commonly include transportation; bridges and buildings; water supply, sewerage, 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 pertaining to the above are also considered a part of civil engineering.

Work on the campus is supplemented by inspection trips which furnish an opportunity for first-hand study of engineering work and industrial plants.

Graduate Study

The department offers major work for the degrees Master of Science and Master of Engineering in civil, sanitary, structural, municipal, highway, soil, and transportation engineering; and major work for the degree of Doctor of Philosophy in structural, sanitary, soil, and transportation engineering. Graduate specialization in geodesy or photogrammetry is also available under civil engineering. Minor work in the above is offered to students taking their major work in other departments.

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.

100. TECHNICAL LECTURE. (1-0) Cr. R. S.
Discussion of various phases of civil engineering. Lectures by staff members and practicing civil engineers.

210. SURVEYING. (2-9) Cr. 5. F.
Prerequisite: Math. 103.
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. (0-9) Cr. 3. F.
Prerequisite: Math. 103.
Principles of surveying measurements, simple topography, site layout and traversing. 211A Primary for students in the College of Agriculture.

212. PHOTOGRAMMETRY, MAPPING AND LAND SURVEYING. (1-6) Cr. 3. W.
Prerequisite: 211
Introduction to photogrammetry. Mapping from stadia and aerial surveys. Land surveying.

213. ROUTE AND HIGHER SURVEYING. (0-9) 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. S.
Prerequisite: Chem., Stat. 201B, credit or classification in E.M. 378.
Elements of hydrology, precipitation, water losses, stream flow and ground water hydraulic.

331. ANALYSIS OF STATICALLY DETERMINE STRUCTURES. (3-0) Cr. 3 F. W.
Prerequisite: Math. 324, or classification in E.M. 326.
Analysis of statically determinate structures. Evaluation of reactions, shears and moments in beams and frames for fixed and moving loads. Stresses in trusses for fixed and moving loads.

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: Credit or classification in 214 or Stat. 201, 201A or 201B.
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. SS.
Prerequisite: Credit or classification in 213 and Stat. 201B.
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. SS.
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 shearing 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: Chem. 103.
Introduction to soil and aggregate materials. 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. 395. PROFESSIONAL DEVELOPMENT. Cr. R. F. W.
(oral reports and discussion of prominent engineers, notable engineering projects and related topics.)

404. ENGINEERING IN CITY PLANNING. (3-0) Cr. 3. W.
Prerequisites: 350, Ur.Pl. 361 or C.E. 426, 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. 202.
Geodetic control surveys. Precise triangulation, trilateration, traversing and leveling. Geodetic computation on the spheroidal. 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. 202.
General theory of geodetic and physical geodesy. Application of geodetic surveys, including gravity, to scientific problems. Size and shape of the earth. Introductory theory of the geoidal isostasy.

417A. 417B. LAND SURVEYING. 417A (1-6) 417B (3-0) Cr. 3 each. S.
Prerequisite: 417A: 213; 417B: credit or classification in 417A.
417A Methods used in original public land sur-
425. SANITARY ENGINEERING I.  
(2-3) Cr. 3. W.  
Prerequisite: 426.  
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.  
Prerequisite: 304, 425, E.M. 378.  
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.

427. SANITARY ENGINEERING III.  
(2-3) Cr. 3. W.  
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. 214.  
Analysis of statically indeterminate structures: Evaluation of reactions, shears and moments in continuous structures; Evaluation of stresses in statically indeterminate trusses.

432A. ANALYSIS OF STATICALLY INDETERMINATE STRUCTURES.  
(4-0) Cr. 4. F. W.  
Prerequisite: 331A.  

433. STRUCTURAL DESIGN IN STEEL.  
(3-0) Cr. 3. F.S.  
Prerequisite: 432, Math 213, E.M. 327 and 354.  
Design and behavior of the elements of steel structures, proportioning of members and connections, introduction to plastic design.

433A. STRUCTURAL DESIGN IN STEEL.  
(3-2) Cr. 4. W.S.  
Prerequisite: 432A, Arch. 343 or E.M. 327 and 354.  

434. REINFORCED CONCRETE DESIGN.  
(3-0) Cr. 3. F.S.  
Prerequisite: 432, Math. 213, E.M. 327 and 354.  
Design and behavior of elements of reinforced concrete structures such as beams, columns, footings and slabs.

434A. REINFORCED CONCRETE DESIGN.  
(3-2) Cr. 4. F.S.  
Prerequisite: 432A, Arch. 343 or E.M. 327 and 354.  
Ultimate strength design of components of reinforced concrete structural systems, beams, one way slabs, two way slabs, flat slabs, columns, footings, etc.

448. ANALYSIS AND DESIGN OF STRUCTURAL SYSTEMS.  
(3-0) Cr. 3. W.  
Prerequisite: 433, 434, credit or classification in Math. 321.  
Analysis of structures by plastic theory and limit design concepts. Analysis of arches in truss to folded plate and cylindrical shell structures.

449. ANALYSIS AND DESIGN OF FLOOR SYSTEMS.  
(3-0) Cr. 3. S.  
Prerequisite: 433, 434, credit or classification in Math. 321.  
Analysis and design of prestressed concrete structures, floor systems, composite beams, one way slabs, flat slabs, steel joist floor systems, etc.

450. TRAFFIC ENGINEERING.  
(3-3) Cr. 4. W.  
Prerequisite: 435.  

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 up process 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 shape 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.  
Characteristics of flow in natural and artificial oceans.
Courses and Programs

 channel, 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.S. Prerequisite: Credit or classification in E.M. 354. Quantity surveys, cost keeping, letting processes 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. 201B, credit or classification in LAd. 365A. The preparation of specifications for structures, highway, and public works developments.

490. ADVANCED CIVIL ENGINEERING. By conference. Cr. 1 to 6. F.W.S.S. Prerequisite: Permission of Instructor. Any phase of civil engineering in which the student has done exceptionally strong work

496. 497. PROFESSIONAL DEVELOPMENT. Cr. R. F.W. Oral reports and discussions on engineering organizations, technical and professional societies, governmental bureaus, ethics and registration

COURSES PRIMARILY FOR GRADUATE STUDENTS, major or minor, open to qualified undergraduates

505. 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; reuse collection and disposal, street and work maintenance; subdivision design and layout


515. ADVANCED GEOMETRIC GEODESY. (3-0) Cr. 3. Alt. F. Offered 1969. Prerequisite: 416. Geodetic geodesy applied to super-long distance measurements. Adjustment of electronic survey nets. Figure of the earth by advanced geometric methods. Three-dimensional world geodetic system


520. WATER AND WASTE WATER ANALYSIS. (0-9) Cr. 3 to 6. W. Prerequisite: 425, Chem. 211 or 214. 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

521. FIELD HYDROLOGY. (2-3) Cr. 3. F. Prerequisite: 304. Collection and analysis of field data concerning precipitation, water losses and stream flow. Use of current hydrologic techniques in hydrologic studies

522. WATER POLLUTION CONTROL PLANT DESIGN. (2-3) Cr. 3. S. Prerequisite: 427, Bact. 200 or Bact. 304. 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: 427, Chem. 211. Investigation and planning activities used to evaluate adequacy of existing municipal water supply and treatment facilities. Design of municipal water treatment facilities

524. 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

526. INDUSTRIAL WASTE TREATMENT. (3-0) Cr. 3. Alt. F.
532. RADIOACTIVITY IN AIR, WATER AND FOOD. (2-3) Cr. 3. S.
Prerequisite: Nuc.E. 510, Chem. 408.
Principles and methods of sampling, identifying and measuring radio-nuclides in air, water and food.

529. LOW-LEVEL RADIOACTIVE WASTES. (3-0) Cr. 3. S.
Prerequisite: Credit or classification in 527.
Sources of radioactive wastes. Principles of handling, treating and disposing of low-level wastes which arise from nuclear energy operations.

532. STRUCTURAL ANALYSIS BY NUMERICAL PROCEDURES. (3-0) Cr. 3. W.
Prerequisite: 433, 434, Math. 321, E.M. 344.
Analysis of structural problems by methods of successive approximations and numerical procedures; moments and deflections of beams under combined axial and bending loads, buckling strength of columns and frames, beams on elastic foundations.

533. STRUCTURAL ANALYSIS BY MATRIX METHODS. (3-0) Cr. 3. S.
Prerequisite: 433, 434, Math. 321.
Analysis of structural problems by means of matrix formulation; flexibility method of analysis, stiffness method of analysis.

534. ADVANCED STRUCTURAL ANALYSIS. (3-0) Cr. 3. F.
Prerequisite: 433, 434, Math. 321.
Rigid frame analysis based on energy concepts, consistent deformation, slope-deflection, moment distribution and column analogy.

536. BRIDGE DESIGN. (3-0) Cr. 3. S.
Prerequisite: 448, 449, Math. 321, E.M. 344.
The bridge as a unit in a transportation system. Clearance requirements for traffic. Economic principles governing the design and relationship of trusses, girders, floors, and bracing. Advantages and limitations of continuous structures. Aesthetic features.

538. MODEL ANALYSIS OF STRUCTURES. (3-0) Cr. 3. W.
Prerequisite: 433, 434, Math. 321.
Theoretical and experimental model analysis of structures. Use of devices and mechanisms for measuring load effects on plane and space structures.

539. PRESTRESSED CONCRETE STRUCTURES. (3-0) Cr. 3. W.
Prerequisite: 433, 434, Math. 321.
Principles of prestressed concrete with applications to structural design.

540. BEHAVIOR OF REINFORCED CONCRETE MEMBERS. Cr. 3 to 6. F.
Prerequisite: 433, 434, Math. 321.
A study of the actual behavior and strength of reinforced concrete members by reviews of experimental and analytical investigations. Flexural members, combined flexure and shear, axially loaded columns, combined flexure and axially loaded members, bond.

544. PLASTIC ANALYSIS AND DESIGN OF STRUCTURES. (3-0) Cr. 3. W.
Prerequisite: 433, 434, Math. 321.
Analysis and design of metal structures by plastic theory. Behavior of metal structures beyond elastic limit.

545. BEHAVIOR OF METAL STRUCTURES. (3-0) Cr. 3. W.
Prerequisite: 433, 434, Math. 321.
Study of the behavior of metals, connections, members and structures, relation between results of research and current specifications for design.

546. ADVANCED STRUCTURAL DESIGN IN METALS. (3-0) Cr. 3. S.
Prerequisite: 433, 434, Math. 321.
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.

547. ANALYSIS AND DESIGN OF PLATE AND SHELL TYPE STRUCTURES I. (3-0) Cr. 3. S.
Prerequisite: 433, 434, Math. 322; E. M. 514.
Analysis and design of plate and shell type structures with particular emphasis on those methods which yield practical solution to structural problems.

553. TRAFFIC ENGINEERING PLANNING AND ANALYSIS. (3-3) Cr. 4. F.
Prerequisite: Credit or classification in 453.
Principles of highway and street traffic planning; traffic analysis by electronic computer methods; driver, vehicle and roadway characteristics; location, safety and capacity of traffic ways.

554. 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 zonings.

555. HIGHWAY ADMINISTRATION AND FINANCE. Cr. 3. F.
Prerequisites: 352, I.E. 304.
Organization and function of highway department's administrative procedures; financial plans, revenues, budgets and controls; sources of revenue.

556. DESIGN OF AEROSPACE TRAFFIC AND TRANSPORTATION FACILITIES. (3-3) Cr. 4. S.
Prerequisite: 453.
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 heliports, airports and spaceports.

560A. SOIL MECHANICS I. (3-4) 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.

560B. SOIL MECHANICS II. (3-0) Cr. 3. W.
Prerequisite: 560A.
Advanced soil mechanics. Slope stability, earth pressures, bearing capacity, piles, and underground conduits.
562. AIRPHOTO INTERPRETATION OF ENGINEERING SOILS.
(2-6) Cr. 4. S.
Prerequisite: 360, Geol. 202 or 301.
Recognition, identification, and mapping of engineering soils from airphotos. Site evaluation. Analytical 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, 361, 362.
Physico-chemical factors affecting soil stability, clay minerals, clay colloid chemistry and effect of chemical additives such as portland cement, lime salts and resins.

567. CONCRETE MATERIALS.
(3-3) Cr. 4. F.
Prerequisite: 362, E.M. 354.

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.

573. GROUND WATER HYDROLOGY.
(3-0) Cr. 3. S.
Prerequisite: 304.
Study of ground water as a source of municipal, industrial, agricultural water supplies; location, occurrence, hydraulics of flow; determination of aquifer and well characteristics, well discharge and pumping test analysis.

585. HIGHWAY CONSTRUCTION METHODS.
(2-2) Cr. 3. S.
Prerequisite: 453, 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, coffer dams and riverworks, heavy concrete structures, retaining walls, tunneling and dam projects.

590. SPECIAL TOPICS.
Cr. 1 to 5 each time elected. F.W.S.S.

† 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

606. MUNICIPAL MANAGEMENT.
Cr. 3 to 6. F.
Utility management, planning improvements, sources of funds, labor relations, public relations, coordination of departments.

622. ADVANCED TOPICS IN WATER POLLUTION CONTROL.
Cr. 3 to 6. Alt. F. Offered 1970.
Prerequisite: 522.
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 1969.
Prerequisite: 523.
Study of advanced concepts in water treatment. Analysis and application of current developments to water treatment methods.

634. SUSPENDED STRUCTURES.
(3-0) Cr. 3. W.
Prerequisite: 534, E.M. 344.
Comparison of analysis of elastic theory, conventional deflection theory, and difference equation method. Consideration of other types of suspended structures.

644. SPACE FRAMES.
Cr. 3 to 6. F.
Prerequisite: 534, Math. 410.
Analysis of complete structures in three planes, including the continuous-frame and the truss-frame types. Interpretation of load strain and displacement measurements.

646. DYNAMIC ANALYSIS OF STRUCTURES.
Cr. 3 to 6. S.
Prerequisite: 533 or 534, E.M. 344.
Single and multi-degree systems, linear and non-linear 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. ANALYSIS AND DESIGN OF PLATE AND SHELL TYPE STRUCTURES II.
(3-0) Cr. 3. F.
Prerequisite: 547.
Advanced topics in the analysis and design of plate and shell type structures.

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.
656. PLANNING TRANSPORTATION SYSTEMS. 
Cr. 3. S. 
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 for a 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.

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 1970. 
Prerequisite: 560B. 
Location, selection of material, design and construction of earth dams. Field trips.

664, 665, 666. STABILITY OF SOILS AND GRANULAR MATERIALS. 
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 1971. 
Prerequisite: 569. 
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 1970. 
Prerequisites: 521; 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.

690. RESEARCH. 
(3-0) Cr. R.

699. SEMINAR. 
(3-0) Cr. R.

CLIMATOLOGY AND METEOROLOGY

For program in Agricultural Climatology, see College of Agriculture, Curriculum in Agronomy and Agronomy, Courses and Programs.

For program in Meteorology, see Sciences and Humanities, Curriculum, and Earth Science, Courses and Programs.

COMPUTER SCIENCE

Professors: Robert J. Lambert, Ph.D.; Clair G. Maple, D.Sc.; Robert M. Stewart, Jr., Ph.D.
Associate Professors: Harrington C. Brearley, Jr., Ph.D.; Howard W. Jesperson, M.S.; Roy F. Keller, Ph.D.; C. C. Mosier, B.S.; Robert A. Sharpe, M.S.; John D. Stevens, Ph.D.; Dale Grosvenor, Ph.D.; Roy Zingg, Ph.D.
Assistant Professor: Wayne O. Ostendorf, 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 (1) graduate study in computer science, or for positions as computer scientists in business, industry or government with an emphasis on (2) numerical analysis, (3) statistics or (4) computer systems engineering.

It is recommended that all majors include 221, 222, 223, 350, 356, 357, 406, 410, 451, 452 and 453. The additional courses recommended for the four options are as follows:

Graduate study: 407, 408, 411, 412; Math. 404, 414, 415, 416.
Computer systems: 411, 412; E.E. 445, 446.

As supporting work undergraduate majors have found the following courses desirable: Math. 110, 111, 112, 213, 421; 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 a 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

Major work in computer science is offered for the degrees Master of Science and Doctor of Philosophy and minor work 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, and the theory of computer organization.

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 related area, such as mathematics, statistics, physics, 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 the languages of Method 2.

The Department of Computer Science requires all graduate students majoring in computer science to 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: 350, 356, 357, 441, 442, 443, 447, 451, 452, 453, 484, 495, 499.

COURSES PRIMARILY FOR UNDERGRADUATE STUDENTS

214. INTRODUCTION TO COMPUTER ORGANIZATION AND PROGRAMMING. (3-0) Cr. 3. F.W.S.
Prerequisite: 10 credits in mathematics and or statistics.
Logical basis of a digital computer system; machine representation of numbers and characters; flow of control; arithmetic and logical operations; indexing; input-output; subroutines; and linkages. Programming in problem oriented languages. Concepts illustrated and problems programmed on available computers. Not open for credit to students who have had 222.

221. COMPUTER ORGANIZATION AND PROGRAMMING I. (3-2) Cr. 4. F.
Prerequisite: 10 credits in mathematics or statistics.
Computer organization, programming concepts, fixed and floating point instructions, branching, looping, indexing and sorting techniques. Recommended primarily for computer science majors and minors.

222. COMPUTER ORGANIZATION AND PROGRAMMING II. (3-2) Cr. 4. W.
Prerequisite: 221.
Subroutines, input-output methods, introduction to monitor systems, introduction to higher level programming languages. Not open for credit to students who have had 214.

223. COMPUTER ORGANIZATION AND PROGRAMMING III. (3-2) Cr. 4. S.
Prerequisite: 222.
Additional programming in higher level languages with emphasis on non-arithmetic problems.

350. INFORMATION STRUCTURES. (3-0) Cr. 3. F.
Prerequisite: 223.
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. W.
Prerequisite: 214 or 222.
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. S.
Prerequisite: 356.
Executive systems for multiprocessing and multiprogramming, input-output control, dynamic storage allocation, interrupts, program library maintenance and up-dating, time-sharing systems.

380. STATISTICAL APPLICATION 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
CIRCUITS.
(E.E. 410) See Electrical Engineering.

411, 412. PRINCIPLES OF DIGITAL
COMPUTER DESIGN I, II.
(E.E. 411, 412) See Electrical Engineering.

441. COMPUTER-ORIENTED BUSINESS DATA
SYSTEMS I.
(2-3) Cr. 3. F.
Prerequisite: I.Ad. 386, or Com. S. 223 and I. Ad. 384.
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.
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.
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.
(3-0) Cr. 3. F.
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 the FORTRAN language. Primarily for graduate students in the biological sciences.

451. ALGEBRAIC LANGUAGES AND
COMPILERS I.
(3-0) Cr. 3. F.
Prerequisite: 214 or 222.
Introduction to languages in general, ALGOL, reference language structure (syntax and semantics) and the study of one ALGOL implementation.

452. ALGEBRAIC LANGUAGES AND
COMPILERS II.
(3-0) Cr. 3. W.
Prerequisite: 451.
A study of PL 1 language structure and PL 1 programming.

453. ALGEBRAIC LANGUAGES AND
COMPILERS III.
(3-0) Cr. 3. S.
Prerequisite: 452.
Compiling techniques, basic compiler construction, polish notation, list and string manipulation.

481. 482. PROCESSING OF STATISTICAL
DATA I, II.
(Stat. 481, 482) See Statistics.

484. COMPUTER TECHNIQUES FOR
BIOLOGICAL RESEARCH.
(3-0) Cr. 3. S.
Prerequisite: 447 or 481.
Review of input-output devices, array manipulation and subroutine usage. Organization and manipulation of large volume data for existing quantitative analysis programs. Examples will be programmed using generalized least-squares procedures.

495. SEMINAR.
Cr. Arr. F.W.S.

499. SPECIAL PROBLEMS.
Cr. Arr. F.W.S.
Prerequisite: 214 or 223.
II Honors Program.

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.
Background in diverse programming languages and systems such as ALGOL, FORTRAN, PL 1, COBOL, SIMSCRIPT, CSS, SOL, LISP, and SLIP. Class projects. 503 will be devoted to a more formal approach to both languages and systems.

507, 508. NUMERICAL SOLUTION OF
ORDINARY DIFFERENTIAL EQUATIONS.
(Math. 507, 508) See Mathematics.

509. COMPUTATIONAL METHODS OF
LINEAR ALGEBRA.
(Math. 509) See Mathematics.

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.
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.
318 Courses and Programs

580, 581. SCIENTIFIC APPLICATION OF DIGITAL COMPUTERS.

582. SWITCHING THEORY.
(E.E. 582) See Electrical Engineering.

584. HIGH SPEED COMPUTER DESIGN.
(E.E. 584) See Electrical Engineering.

585. ADVANCED COMPUTER ORGANIZATION.
(E.E. 585) See Electrical Engineering.

586. THEORY OF COMPUTER ORGANIZATION.
(E.E. 586) See Electrical Engineering.

599. SPECIAL TOPICS.
F.W.S.

COURSES FOR GRADUATE STUDENTS, major or minor

607. ADVANCED TOPICS IN NUMERICAL ANALYSIS.
(Math. 607) See Mathematics.

610. SEMINAR.

684. ADVANCED SWITCHING THEORY.
(E.E. 684) See Electrical Engineering.

685. ADVANCED LOGIC SYSTEMS.
(E.E. 685) See Electrical Engineering.

699. RESEARCH.
Graduate Staff.

CROP SCIENCE

For description of courses, see Agronomy.

DAIRY AND FOOD INDUSTRY

Verner H. Nielsen, Ph.D., Head of Department


Associate Professors: Darrel E. Goll, Ph.D.; Allen A. Kraft, Ph.D.; William S. LaGrange, Ph.D.; Winfield S. Rosenberger, B.S.; Robert E. Rust, Ph.D.; Marvin H. Stromer, Ph.D.; David C. Topel, Ph.D.; Earl O. Wright, M.S.

Assistant Professors: Fred C. Parrish, Ph.D.; Lowell D. Satterlee, Ph.D.; Rupert G. Seals, Ph.D.; Ebenezer R. Vedamuthu, Ph.D.

Instructors: Robert V. Ogden, M.S.; Richard J. Smith, M.S.

Undergraduate Study

Food technology is the application of science 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 option 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

Major work is offered for the degrees Master of Science and Doctor of Philosophy in food technology and dairy microbiology. 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.

Courses open to graduate students for minor credit only: 305, 306, 307, 347, 348, 412, 413, 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

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.
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.
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 or 304.
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.

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.

347, 348. DAIRY CHEMISTRY.
(B. & B. 347, 348) (3 or 6) Cr. 3 or 5 each.
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 dairy products. H. Honors Program.

407. SPECIAL PROBLEMS IN DAIRY AND FOOD TECHNOLOGY.
(0-6 or 9) Cr. 2 or 3. F.W.S.S.S1.SS1.
Prerequisite: Junior classification, quality point average of 2.5 or more for preceding two quarters.

Field trips.

412. FOOD PRESERVATION.
(Bact. 412) (3-0 or 6) Cr. 3 or 5. F.
Prerequisite: Bact. 300 or 304.
Preservation, maintenance of quality of food products. Field trips.

413. MICROORGANISMS IN FOODS.
(Bact. 413) See Bacteriology.

414. FOOD, MILK AND WATER SANITATION.
(Bact. 414) (3-0 or 6) Cr. 3 or 5. S.
Prerequisite: Bact. 200 or 304.
Control of biological, chemical and physical environments in maintaining proper sanitation and safety of foods and water. Regulations governing sanitation. Field trips.
COURSES AND PROGRAMS

449. FOOD CHEMISTRY.
(B. & B. 449) (3-6) Cr. 3 or 5. S.
Prerequisite: Chem. 211, 335 or 231.
Application of proximate and physiochemical methods of analysis to the general composition of common food types and to determination of coloring materials, preservatives and metals in foods.

450. DAIRY MICROBIOLOGY.
(Bact. 450) (3-6) Cr. 5. F.
Prerequisite: Bact. 300 or 304.

491. 492, 493. FOOD PROCESSING EQUIPMENT.
(3-0 or 3) Cr. 3 or 4. F.W.S.
Prerequisite: Math. 110, Phys. 112.
Design and operation of food processing equipment considering materials handling, heat and mass transfer, fluid mechanics, steam, refrigeration and automation. Field trips

COURSES PRIMARILY FOR GRADUATE STUDENTS, major or minor, open to qualified undergraduates

547. FOOD TECHNOLOGY.
(2 or 3-0) Cr. 2 or 3. F.W.S.
Prerequisite: Permission of instructor.
Selected topics in food technology such as food color, colloidal phenomena, rheology, flavor evaluation, lipid stability, government regulation, radionuclides. Schedule of presentation will be announced.

559. ADVANCED DAIRY MICROBIOLOGY.
(Bact. 559) (3-6 or 6) Cr. 3 or 5. W.
Prerequisite: 450. 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. LIPID CHEMISTRY.
(B. & B. 623) See Biochemistry and Biophysics.

640. FOOD PROTEINS.
(3-0) Cr. 3. Alt. F. Offered 1969.
Prerequisite: B. & B. 501 or permission of instructor.
Fundamental properties of protein systems found in milk, eggs, meat and cereal grains. Effect of processing on food proteins.

656. SYSTEMATIC DAIRY MICROBIOLOGY
(Bact. 656) (1-9) Cr. 4. S.
Prerequisite: 450. Reinbold.
Identification and classification of microorganisms commonly found in milk products.

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.

690. RESEARCH.
D Food Technology. Bird, Carlin, Goll, Hammond, Hartman, Kline, Kraft, Marion, Parrish, Reinbold, Seals, Snyder, Topel, Vedamuthu, Walker.

DAIRY SCIENCE

For description of courses, see Animal Science.

DESIGN CENTER

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

Department of Architecture
- Architecture
- Building Construction (Civil Engineering)
- Urban Design

Department of Landscape Architecture
- Landscape Architecture
- Urban Planning
- Town and Regional Planning

Details of each curriculum will be found in the appropriate departmental section.

Courses Administered by the Design Center

Courses listed below are offered for undergraduate students in all curricula of the University.

125, 126, 127. UNDERSTANDING THE ENVIRONMENTAL ARTS.
(3-0) Cr. 3 each. Yr.

The integration of landscape architecture, urban design, architecture, sculpture, painting, and the allied arts in different cultures. No prerequisites to any quarter.

DISTRIBUTED STUDIES

Chalmer J. Roy, Ph.D., Dean of the College of Sciences and Humanities
John J. L. Hinrichsen, Ph.D., Associate Dean
Frank E. Bortle, Ph.D., Assistant Dean
Charles Clark Bowen, Ph.D., Assistant Dean
Millard R. Kratochvil, M.A., Assistant Dean
William R. Underhill, Ph.D., Chairman, Teacher Education Committee,
College of Sciences and Humanities

Oscar E. Tauber, Ph.D., Chairman, Committee for Graduate Programs in General Science


Associate Professor: Carl Vondra, Ph.D.

Assistant Professor: Floyd Pace, M.S.; Phillip B. Zaring, Ph.D.

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. Pre-professional students should consider the desirability of a program which combines three years of pre-professional, and the first year of professional study to meet the requirements for the degree Bachelor of Science. (See Pre-professional 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

The degree Master of Science with a major in general science 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 pass the usual examination for reading proficiency in a foreign language. Languages used to satisfy this requirement may be French, German, Spanish or Russian. Permission to present other languages in lieu of these will depend on demonstration by the student that the language will be useful to him professionally. 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 contact the program chairman as soon as possible so that the committee for direction of the course of study may be appointed.

Under sponsorship of the National Science Foundation, the College has administered summer institutes for college teachers of mathematics and statistics and for high school teachers of biology, chemistry, earth science, mathematics and physics. The institutes have emphasized special preparation in subject matter. The institutes for college teachers have been based on selected topics from regular course offerings. Since institute programs vary from year to year, interested persons should inquire of the Graduate College Dean's Office.

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 elected. F.W.S. Prerequisite: Permission of instructor. Experimental or Honors courses offered by any department or interdepartmental group.

104, 105, 106. INTRODUCTION TO AFRICAN STUDIES. (3-0) Cr. 3 each Yr. Prerequisite: 106: 104 or 105. 104: the African continent, people and cultures, 105: survey of African history, 106 Africa in world affairs.

301, 302, 303. STUDIES IN SCIENCES AND HUMANITIES. Cr. 1 to 5 each time elected. F.W.S. Prerequisite: Junior standing and permission of instructor. Experimental or Honors courses offered by any department or interdepartmental group.

417. OBSERVATION AND SUPERVISED TEACHING. Cr. 2 to 12 each time elected; maximum permitted 12 credits. F. Prerequisite: Educ. 305; Engl. 494 or Sp. 495 or Math. 497 or ScL 486 or 496 or P.E.M. 497 or F.L. 476; advance reservation required. Observation, evaluation of instruction, lesson planning, and teaching in the sciences and humanities.

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<th>B Physical Sciences</th>
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<td>C Mathematics</td>
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<td>E English and Literature</td>
<td>F Physical Education for Men</td>
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480. SPECIAL PREPARATION IN SUBJECT MATTER FOR ELEMENTARY AND SECONDARY TEACHERS. Cr. arr. Maximum of 12 credits in each area listed below:

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486. METHODS OF TEACHING SCIENCE. (3-0) Cr. 3. W. Prerequisite: Admission to Teacher Education and 15 credits in subject matter field. Field trips

496. METHODS OF TEACHING SOCIAL STUDIES. (3-0) Cr. 3. W. Prerequisite: Admission to Teacher Education and 15 credits in subject matter field. Field trips

499. SPECIAL TOPICS. Cr. 1 to 5 each time elected. F.W.S.S. Prerequisite: Junior standing and permission of instructor.

1These course numbers may be used only with the permission of the Dean of the College and concurrence by the Sciences and Humanities Curriculum Committee.
EARTH SCIENCE

Keith M. Hussey, Ph.D., Head of the Department

Professors: Charles S. Gwynne, Ph.D.; John Lemish, Ph.D.; Chalmer J. Roy, Ph.D.; Donald L. Biggs, Ph.D.

Associate Professors: Karl E. Seifert, Ph.D.; Lyle V. A. Sendlein, Ph.D.; Carl F. Vondra, Ph.D.

Assistant Professors: W. Gale Biggs, Ph.D.; Robert C. Palmquist, Ph.D.; Douglas N. Yarger, Ph.D.; Robert D. Cody, Ph.D.

Instructors: James H. Elwell, M.S.; Gary D. Johnson, M.S.; Jane T. Zaring, M.A.

Undergraduate Study

For undergraduate curriculum in sciences and humanities leading to the degree of 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 III requirements in the College of Sciences and Humanities; geography courses may be used in Group V. The following programs are recommended to students concentrating in the various fields of study in earth science:

Students majoring in earth science usually complete the following courses: Geog. 201, 322 or Geol. 211; Geol. 100, 171, 202, 261, 340, 431; Mteor. 206, 207, 406; Phys. 151 and 10 additional credits in approved courses.

Students majoring in geology generally complete the following courses: Geol. 100, 171, 202, 351, 352, 361, 371, 381, 431, 440, and 492. Minor work is recommended in mathematics and one of the following fields: chemistry, civil engineering, computer science, physics, statistics or zoology.

Students specializing in geophysics commonly take the following courses: Geol. 171, 202, 301, 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, 207, 406, 421, 441, 442, 443 and eight additional credits. Minor work is recommended in chemistry, 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 major work for the degrees of Master of Science and Doctor of Philosophy in earth science, geology, and meteorology, and minor work to students majoring in other departments. 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.

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. 340, 351, 352, 361, 371, 381, 400, 401, 402, 407, 411, 431, 440, 490, 492; Mteor. 311, 406, 421, 441, 442, 443 and 490.
COURSES PRIMARILY FOR UNDERGRADUATE STUDENTS

Geography

201. WORLD GEOGRAPHY. (3-0) Cr. 3. F.
The character and distribution of the elements comprising man's physical environment and inter-relationships of the man-environment system.

202. SUMMER FIELD WORK. Cr. 8-12. SS.
An eight-week summer field course, required of all geography majors. Areal mapping, structural, stratigraphic and geomorphic analyses. Written reports with appropriate illustration required.

203. GEOLOGY FIELD TRIP. Cr. 1 each time taken. F. W. S.
Prerequisite: 100, permission of instructor. The geology of selected regions is studied by correlated readings and report presentation followed by a field trip to points of geologic interest in these regions.

211. OCCURRENCE AND CONSERVATION OF MINERAL RESOURCES. (3-0) Cr. 3. F.
Prerequisite: 100. Types of mineral resources; their geologic distribution in time, space and environment; their manner of occurrence or origin; need and methods for conservation.

324. CULTURAL GEOGRAPHY—EUROPEAN AND AMERICAN. (3-0) Cr. 3. W.
A study of the climate and physical geography of Europe, and North, Central and South America, and their influence on the cultural development of man in those areas.

325. CULTURAL GEOGRAPHY—AFRICAN, ASIAN, AUSTRALIAN AND PACIFIC ISLAND. (3-0) Cr. 3. S.
A study of the climate and physical geography of Africa, Asia, Australia, and the Pacific Islands and their influence on the cultural development of man in those areas.

326. LIFE IN THE GEOLOGIC PAST. (3-0) Cr. 3. W.
Prerequisite: 100. Significant events in the development of life upon earth. Principles by which fossils can be used for reconstructing environments of the past. The pattern and principles of development of life as they relate to modern fauna and flora.

327. GEOLOGY FOR ENGINEERS. (2-3) Cr. 3. F. S.
Fundamentals of the science and engineering application. Field trips.

328. MINERALOGY. (2-6) Cr. 4. F.
Prerequisite: Chem. 102. Geochemistry of silicates and other rock-forming minerals; determinative mineralogy.

329. OPTICAL MINERALOGY. (2-6) Cr. 4. W.
Prerequisite: 351. Relationships of structure, symmetry and optical properties of transparent crystals. Study of principal rock forming minerals with polarizing microscope.

330. INVERTEBRATE PALEONTOLOGY. (2-6) Cr. 4. S.
Prerequisite: 100. Characteristics and relationships of invertebrates of fossil record; their use in historical geology. Field trips.
371. PETROLOGY.  
(2-6) Cr. 4. S.  
Prerequisite: 351, Math. 112.  
Physiochemical properties and behavior of rocks as a function of their environment. Microscopic identification and study of common rock types. Field trips.  

381. STRUCTURAL GEOLOGY.  
(3-3) Cr. 4. W.  
Prerequisite: 100, permission of instructor.  
Structure of earth's crust and interpretations of rock structures.  

400. ADVANCED FIELD GEOLOGY.  
Cr. 8-12. SS.  
Prerequisite: 371, 381, 492.  
An eight week field course for the advanced geology major emphasizing advanced field techniques and providing the student with experience in analyzing geologic field problems.  

401. GEOLOGY OF EASTERN NORTH AMERICA.  
(3-0) Cr. 3. F.  
Prerequisite: 371, 381.  
Coastal Plains, Appalachians, West Indies, Central Interior and Canadian Shield.  

402. GEOLOGY OF WESTERN NORTH AMERICA.  
(3-0) Cr. 3. W.  
Prerequisite: 371, 381.  
Rockies, Basin and Range, Sierra Nevadas, Cascades and Coast Ranges.  

407. GEOLOGIC INTERPRETATION OF AERIAL PHOTOGRAPHS.  
(1-6) Cr. 3. Alt. F. Offered 1969.  
Prerequisite: 100.  
Brief introduction to the 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.  
Nature and origin of mineral deposits.  

431. GEOMORPHOLOGY.  
(3-3) Cr. 4. F.  
Prerequisite: 100.  
The interrelationship between geomorphic processes and earth materials in the development of landforms; the use of landforms in the interpretation of recent geologic history. Saturday field trips.  

440. PETROPHYSICS.  
(2-6) Cr. 4. W.  
Prerequisite: 202, 371, 381, Math. 213, Phys. 223.  
A study of the physical properties of rocks, including porosity, permeability, elastic properties, and heat and electrical conductivity. Rocks will be studied through laboratory investigations to establish their relationship to natural geologic materials and processes.  

455. INTRODUCTION TO HYDROSPACE ENGINEERING.  
(Aer.E. 455) See Aerospace Engineering.  

490. SPECIAL PROBLEMS.  
Cr. 2 to 4 each time taken. F. W. S.  
Prerequisite: 100, permission of instructor.  
H. Honors Program.  

492. STRATIGRAPHY.  
(3-3) Cr. 4. F.  
Prerequisite: 371.  
Principles of interpreting the geologic record. Significant events of the geologic past.  

COURSES PRIMARILY FOR GRADUATE STUDENTS, major or minor, open to qualified undergraduates  

Geology  

501. SEMINAR.  
Cr. 1 each time elected. F. W. S.  

512. ADVANCED ECONOMIC GEOLOGY.  
(3-0) Cr. 3. Alt. W. Offered 1971.  
Prerequisite: 411. Lemish.  
Geology applied to mining; significant deposits and districts.  

515. GEOCHEMISTRY.  
(3-6) Cr. 5. Alt. F. Offered 1969.  
Prerequisite: Chem. 211, 301, permission of instructor. Lemish.  
Emphasis on chemistry of geological processes related to changes in earth materials.  

521. SEDIMENTATION.  
(3-4) Cr. 5. Alt. W. Offered 1970.  
Prerequisite: 492, 515. Cody.  
Weathering of rocks, transportation and deposition of clastic and non-clastic sediments.  

531. QUATERNARY GEOLOGY.  
(3-0) Cr. 3. Alt. S. Offered 1970.  
Prerequisite: 431. Palmquist.  
The use and interpretation of variations in the character of landforms, sediments, and fossils in the reconstruction of Quaternary events and environments. Saturday and weekend field trips.  

532. DYNAMICS OF GEOMORPHIC SYSTEMS.  
(2-1) Cr. 3. Alt. S. Offered 1971.  
Prerequisite: 431. Palmquist.  
Analysis of geomorphic systems acting under various constraints and of the resulting landforms.  

535. GROUNDWATER GEOLOGY.  
(2-3) Cr. 3. Alt. W. Offered 1970.  
Prerequisite: 440, C. E. 304. Sendlein.  
Occurrence and distribution of subsurface water; nature of conducting media.  

551. ADVANCED MINERALOGY.  
(2-3) Cr. 3. Alt. S. Offered 1970.  
Prerequisite: 352. D. L. Biggs.  
Structural, chemical and paragenetic relationships of common rock-forming minerals.  

561. VERTEBRATE PALEONTOLOGY.  
(3-3) Cr. 4. Alt. F. Offered 1969.  
Prerequisite: 361, Zool. 224. Vondra.  
The (cranial, dental and post cranial) morphology, taxonomy, evolution and distribution of fossil vertebrates with emphasis on the mammals.  

565. INVERTEBRATE PALEONTOLOGY.  
(2-6) Cr. 4. Alt. W. Offered 1971.  
Prerequisite: 361. Cody, Vondra.  
Selected topics in paleontology and paleoecology: sedimentary environments and their effects on organisms, stratigraphic correlation, interpretation of earth history, advanced morphologic descriptions of fossils.  

571. IGNEOUS AND METAMORPHIC PETROLOGY.  
(2-6) Cr. 4. Alt. F. Offered 1970.
COURSES FOR GRADUATE STUDENTS, major or minor

Geology

651. CLAY MINERALOGY.
(2-3) Cr. 3. Alt. W. Offered 1970.
Prerequisite: 551, Chem. 323. D. L. Biggs.
Geological significance, structure and chemistry of the clay minerals.

672. ADVANCED SEDIMENTARY PETROLOGY.
(2-6) Cr. 4. Alt. S. Offered 1971.
Prerequisite: 571. D. L. Biggs.
Advanced study of the petrology and petrography of sedimentary rocks. Field trips.

675. ROCK DEFORMATION.
(2-6) Cr. 4. Alt. W. Offered 1971.
Prerequisite: 581, Math. 213. Seifert, Sendlein.
Theory and experimental conditions for rock deformation; stress-strain relations. Deformation of selected rocks.

678. DEFORMATION OF MINERALS.
(2-6) Cr. 4. Alt. S. Offered 1971.
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 1970.
Prerequisite: 371, 381, 492. Hussey, Roy.
The distribution and dynamic history of sedimentary basins and mountain ranges of the world.

COURSES PRIMARILY FOR UNDERGRADUATE STUDENTS

Meteorology

206. INTRODUCTION TO METEOROLOGY.
(Agron. 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.

207. METEOROLOGY LABORATORY.
(0-3) Cr. 1. F. W. S.
Prerequisite: Classification in 206 or 311. Thermodynamic diagrams, concepts of atmospheric stability, map problems.

311. AVIATION METEOROLOGY.
(2-0) Cr. 2. F.
Prerequisite: Classification in 207. Application of meteorology to aviation.

406. CLIMATES OF THE CONTINENTS.
(Agron. 406) See Agronomy.

421. METEOROLOGICAL INSTRUMENTS.
(2-3) Cr. 3. W.
Prerequisite: 3 credits of meteorology. Math. 112, Phys. 112 or 223.
Theory and techniques of conventional meteorological instruments. The limitations of specific instruments and systems encountered in field and laboratory measurements. Emphasis will be placed on theory and calibration of instruments.

441, 442, 443. INTRODUCTION TO THEORETICAL METEOROLOGY I, II, III.
(4-0) Cr. 4 each Yr.
Prerequisite: 441: Phys. 112 or 223, Math. 112; 442: 441; 443: 442.
441 (Thermodynamics) The development of the equation of state for an ideal gas from experimental laws and from small kinetic theory arguments. The first law of thermodynamics, specific heats, real gases, the thermodynamics of water vapor, mixtures of gases, thermodynamic diagrams. 442 (Physics) Basic radiation laws, solar and terrestrial radiation, the Elsasser diagram, radiative transfer, cloud physics, atmospheric electricity; 443 (Dynamics) The equation of motion on a rotating earth, horizontal motion, kinematics of fluid flow, circulation, vorticity and divergence theorems, the equation of continuity, the thermal wind.

490. SPECIAL PROBLEMS.
Cr. arr. F. W. S.
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.
515, 516. SYNOPSTIC METEOROLOGY I, II. (1-6) Cr. 3 each. 515: Alt. W. Offered 1971; 516: Alt. S. Offered 1971. Prerequisite: 443. Air mass analysis, three dimensional analysis of fronts and pressure systems, construction of meteorological charts for forecasting the weather, elements, graphical determination of thickness patterns, numerical analysis on high speed computers.
543, 544. DYNAMIC METEOROLOGY I, II. (4-0) Cr. 4 each. 543. Alt. W. Offered 1970; 544: Alt. S. Offered 1970. Prerequisite: 543: 443; 544: 543. 543: Equations of motion, horizontal frictionless flow, variation of the wind and pressure fields in the vertical direction, wind structure in the friction layer, the diffusion of heat, water vapor, and atmospheric pollutants, the geostrophic gradient, and thermal winds. 544: Frontogenesis, surfaces of discontinuity, mechanism of pressure change, vorticity and circulation, perturbation theory, jet stream, numerical analysis of barotropic and baroclinic models, the cyclones and anticyclones.
571, 572. CLOUD PHYSICS I, II. (3-0) Cr. 3 each. 571: Alt. W. Offered 1971; 572: Alt. S. Offered 1971. Prerequisite: 443 or 542. 571: Cloud dynamics, thermodynamics of phase change and nucleation, numerical techniques in cloud physics, condensation nuclei and ice nuclei, diffusion 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. Arr. Prerequisite: Permission of instructor.

COURSES FOR GRADUATE STUDENTS, major or minor

Meteorology

605. MICROMETEOROLOGY (5-0) Cr. 5. F. Prerequisite: 505. 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. W. Prerequisite: Permission of instructor.

Analysis and statistics of atmospheric turbulence, theoretical treatment of atmospheric diffusion, K-theory, the effects of buoyant motion, the estimation of diffusion from meteorological data.
690. SPECIAL TOPICS. Cr. arr. F. W. S. Prerequisite: Permission of instructor.
695. RESEARCH. Cr arr. Prerequisite: Permission of instructor.
ECONOMICS

Karl A. Fox, Ph.D., Head of the Department


Assistant Professors: Lon Cesal, Ph.D.; J. Ronnie Davis, Ph.D.; Paul D. Doak, Ph.D.; Arnold M. Faden, Ph.D.; Leo Mayer, Ph.D.; Neil A. Palomba, Ph.D.; Marvin Skadberg, Ph.D.; Robert W. Wisner, Ph.D.


Undergraduate Study

Programs of study offered in both the College of Agriculture and the College of Sciences and Humanities are outlined in this section. Students majoring in economics may substitute a second major in international relations for the two minors required in the College of Sciences and Humanities. See Index, International Relations.

College of Agriculture

For undergraduate curriculum in agricultural business leading to the degree Bachelor of Science, see College of Agriculture, Curricula.

Students majoring in agricultural business must develop one minor but may include two in their academic program. One minor must be selected from the following: economic analysis, farm management, marketing management, public policy and agricultural communications. The other minor may be in related departmental areas. The curriculum prepares students for advanced studies and for careers in farm credit and appraisal, agricultural marketing industries, commercial farm management, independent farming, research for business firms, agricultural journalism and communication, agricultural Extension and government service.


College of Sciences and Humanities

For undergraduate curriculum in sciences and humanities with a major in economics, see College of Sciences and Humanities, Curriculum. The basic sequence of courses is 241, 242, 307, 308, 409.
A variety of programs can be developed within the economics major depending on the interests and career goals of the individual students. All of these programs are based on the required sequence with additional courses chosen to support the student's objectives. Among the programs are labor and industrial relations, pre-law, general business, international trade and development, and urban and regional economics. Many other programs are available. These programs have been designed to offer substantial flexibility while providing the student with the basic knowledge necessary to pursue his goals.

**Graduate Study**

The department offers major work for the degrees Master of Science and Doctor of Philosophy 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. 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 below. 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.

**Fields of concentration for Ph.D. candidates:**

- 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 and Manpower Economics
- Monetary Economics
- Operations Research
- Production Economics and Farm Management
- Public Finance and Fiscal Policy
- Regional-Urban Economics
- Resource Economics and Area Development

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.
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.
Restricted to freshman or sophomore classification.
A student cannot count credit for both 130 and 330 toward a degree. 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.

•190. SUPERVISED PRACTICE. Cr. 1 to 12. F.S.S.
Prerequisite: 9 credits in economics.
Twelve to 24 weeks of full-time observation and supervised experience in the employment of selected agricultural businesses. Not more than six credits will apply toward a B.S. degree.

241, 242, 243. PRINCIPLES OF ECONOMICS. (3-0) Cr. 3 each. F.W.S.S.SI.

•292. MARKETING BUSINESS OPERATIONS. (3-2) Cr. 4. F.S.
Prerequisite: 6 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.S.SII.
Prerequisite: 242.

306. COMPARATIVE ECONOMIC SYSTEMS. (3-0) Cr. 3. F.
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.SI; 308: W.S.S.SII.
Theory of consumption and of the business firm, competitive and monopolistic markets, distribution of income, general equilibrium of the pricing system.

313. CONSUMPTION ECONOMICS. (3-0) Cr. 3. S.
Prerequisite: 242.
An analysis of household decision-making, the economic consequences of consumer behavior; consumption in growing economies.

314, 315. MONEY AND BANKING. (3-0) Cr. 3 each. 314: F.W.S.SII; 315: W.S.S.SII.
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.

•329. 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.

•330. FARM MANAGEMENT AND ORGANIZATION. (3-2) Cr. 4. F.S.S.S.
Prerequisite: 242; 329 or I.Ad. 384 recommended.
A student cannot count credit for both 330 and 330 toward a degree. Organization and management of a farm with emphasis on use of economic principles. Enterprise selection, size of business, budgeting, leases, layout and farm analysis.

•335. AGRICULTURAL MARKETING. (3-0) Cr. 3. F.W.S.S.SI.
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. W.
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, hedging methods for livestock and grain producers and other marketing agencies.

•403. MARKETING LIVESTOCK AND MEAT. (An.S. 403) (3-0) Cr. 3. S.
Prerequisite: 242.
The demand, supply, and distribution of live stock and meat. Analysis of changes in marketing methods, grades, values, prices and costs. One all-day field trip.

405. PUBLIC FINANCE. (3-0) Cr. 3. F.S.
Prerequisite: 242.
Economic aspects of public expenditures, public borrowing and taxation with special attention to incidence of taxation, debt creation and federal-state local fiscal interrelationships.
409. NATIONAL INCOME AND EMPLOYMENT. (3-0) Cr. 3. F.W.S.SSI.
Prerequisite: 242.
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. COMPOSITION IN THE AMERICAN ECONOMY. (3-0) Cr. 3. S.
Prerequisite: 308.
Factors determining competitive behavior in representative American industries, economic aspects of social evaluation of competitive performance.

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.

415. ECONOMICS OF CONSUMPTION. (F.E. 415) See Family Environment.

*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. (2-0) 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. LAND RESOURCE ECONOMICS. (3-0) Cr. 3. F.S.
Prerequisite: 242.
Land resources including soil, water, forests, locations, etc., in the production process. Land resources and population interrelationships. Types and intensities of uses including urban, recreational, agricultural, private and public interests. Land resource uses and tenure policies, conservation.

*435. AGRICULTURAL FINANCE. (3-0) Cr. 3. W.
Prerequisite: 242.
Financial requirements of individual farmers and of farm cooperative organizations. Farm credit policy, Farm Credit Administration and other lending institutions. Field trips.

*436. AGRICULTURAL MARKETING ANALYSIS. (3-0) Cr. 3. W.
Prerequisite: 308, 335.
Analysis of demands, costs and efficiency in agricultural marketing, processing and farm supply organizations. Analysis of the price making processes as related to agricultural commodity 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, composition 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: 308 or 242; Math. 110.
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.W.
Prerequisite: 305.

*447. INTRODUCTION TO AGRICULTURAL POLICY. (3-0) Cr. 3. F.W. Alt. SSI. Offered 1971.
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.SSI.
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: 242, 315 or 455 recommended.
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.
Pre-requisite: 242.
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.
Pre-requisite: 242.
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.

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.S.; 502: W.S.S.S. Pre-requisite: 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 non-perfect 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.
Pre-requisite: 409. Brady, Starleaf.
Determinants 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, neo-classical, Keynesian, and neo-Keynesian models.

510. LAND RESOURCE USE AND CONSERVATION.
(3-0) Cr. 3. Alt. W. and SS. Offered 1970.
Pre-requisite: 308 or 434. Harl, Thomas, Timmons.
Land resources, classification and economic limits, disinvestment in water, soil, forest, minerals, etc. Meaning of conservative use limits. Economic principles applied to land resource use. Appraisal of public controls, public programs and group action.

512. AGRARIAN REFORM AND ECONOMIC DEVELOPMENT.
(3-0) Cr. 3. W.
Pre-requisite: 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.

515. INDUSTRIAL STRUCTURES AND COMPETITION.
(3-0) Cr. 3. W.
Pre-requisite: 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.

516. ECONOMIC ASPECTS OF ANTITRUST AND TRADE REGULATION.
(3-0) Cr. 3. S.
Pre-requisite: 515. Harl.
Analysis of the legal manifestations of national economic antitrust and trade regulation policy, rationale for public intervention in industrial organization and price output policy, exemptions from antitrust law, price control; market divisions and agreements not to compete, refusals to deal, monopoly, merger, resale price maintenance; discrimination in distribution, unfair trade practices, remedies under antitrust law, effectiveness of antitrust policy.

520. FOOD ECONOMICS.
(F.E. 520) See Family Environment.

531. AGRICULTURAL MARKET ORGANIZATION AND BUSINESS BEHAVIOR.
(3-0) Cr. 3. F.
Pre-requisite: 501. Fletcher, Scott.
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.
Examination of models and theories from economics and other social sciences relevant to marketing and forecasting problems, use of these models and theories for hypothesis formulation, selection and use of quantitative techniques.

533. RESEARCH DESIGN IN AGRICULTURAL MARKETING.
(3-0) Cr. 3. S.
Pre-requisite: 501. Fletcher, Doak.
Current problems in agricultural markets and marketing, integration of theory, models, tech-
niques 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.

535. ECONOMIC DEVELOPMENT AND TRANSFORMATION OF AGRICULTURE.
(3-0) Cr. 3. Alt. W. Offered 1970.
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.

536. BUSINESS FLUCTUATIONS.
(3-0) Cr. 3. Alt. S. Offered 1971.
Prerequisite: 409 or 503. Brady, Starleaf.
Dynamic theories of fluctuations in aggregate demand and aggregate economic activity.

537. LINEAR ECONOMIC MODELS.
(3-0) Cr. 3. F.
Prerequisite: 307, Math. 102 or 104. Ladd.
Selected applications of mathematics to economic problems; includes game theory, linear programming, and input-output analysis.

538. ELEMEN TARY ECONOMETRIC STATISTICS.
(Stat. 538) See Statistics.

539. OPERATIONS RESEARCH METHODS.

540. OPERATIONS RESEARCH METHODS AND ECONOMIC ANALYSIS.

541. AGRICULTURE IN THE WORLD ECONOMY.
(3-0) Cr. 3. SSII.
Prerequisite: 242. Kaldor.
International comparison of development, adaptation, instability and income problems in agriculture; world agricultural specialization and trade; policies of food importing and exporting nations and role of national and international agencies in agricultural development.

544. FISCAL THEORY.
(3-0) Cr. 3. F.
Prerequisite: 501. Davis, Meyer.
Determination of public expenditure and tax policies; tax structures and shifting and incidence of taxes; policies and methods of income redistribution; non-market decision making.

545. FISCAL POLICY.
(3-0) Cr. 3. W.
Prerequisite: 503. Davis, Meyer.
Stabilization policy; economics of the public debt. Fiscal policy and economic growth. Selected policy issues.

548. QUANTITATIVE AGRICULTURAL PRICE ANALYSIS.
(3-0) Cr. 3. S.
Prerequisite: 307. Doak, Scott.
Measurement of supply and demand for agricultural products. Integration of government reports into 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.
Theories of the rate of interest; the neo-quantity theory; the portfolio approach to monetary theory; microeconomic aspects of monetary 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 1970.
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. Ball, Kaldor.
Short-run 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. Talbot, Kaldor.
Politico-economic 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.

564. STATE-LOCAL FINANCE.
(3-0) Cr. 3. W.
Prerequisite: 405 or 544. Pol. S. 310 recommended. Prescott, Meyer.

565. ECONOMICS OF LOCATION.
(3-0) Cr. 3. Alt. S. Offered 1970.
Prerequisite: 501. Faden.

568. URBAN ECONOMICS. (3-0) Cr. 3. Alt. S. Offered 1971. Prerequisite: 501. Faden, Prescott. History of world urban development; economic foundations of the city; agglomerating forces; linkages, theories of city growth—ring theories, sectoral theories, multiple nucleation, city system and urban hierarchies, coresuburban, hinterland relations and size distributions, commuting patterns, land-use patterns, CBD functions; metropolitan problems, transportation, housing, congestion and neighborhood effects.


588. FAMILY ECONOMICS. (F.E. 588) See Family Environment.


591. COMPARATIVE TRADE UNIONISM. (3-0) Cr. 3. Alt. S. Offered 1971. 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 to free trade union movements in newly emerging nations and economically underdeveloped areas.


593. WAGES AND THEORIES OF WAGE DETERMINATION. (3-0) Cr. 3. Alt. F. Offered 1970. 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 1971. 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 1970. 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.

599. SPECIAL TOPICS. Cr. 1 to 5 each time taken. F.W.S. *A Agricultural Economics B Economics

*Offered by the College of Agriculture. Courses not marked by an asterisk are offered by the College of Science and Humanities.

COURSES FOR GRADUATE STUDENTS, major or minor


605, 606. HISTORY OF ECONOMIC DOCTRINES. (3-0) Cr. 3 each. F.W. Prerequisite: 502, 503. Davis, 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. Critics of the Classical School to J.M. Keynes.

•630. ADVANCED LAND ECONOMICS.
(3-0) Cr. 3. F.
Prerequisite: 308 or 434. Harl, 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. F.
Prerequisite: 603. Holdren.

•670. RESOURCE ALLOCATION IN FORESTRY.
(For. 670) See Forestry.

680, 681. SEMINAR IN URBAN-REGIONAL ECONOMICS.
Prerequisite: 680: 502 recommended; 681: 680. Faden, Fox, Prescott. 680: Study of the advanced literature in urban-regional economics; topics include linear models, social accounting, gravity models, area delineation, urban-regional econometric systems, decomposition techniques, and single-equation regression. 681: Preparation and presentation of research papers. Topics include urban-regional growth models, industrial complex analysis, normative analysis, simulation techniques, and comparative economic planning.

690. WORKSHOP IN ECONOMIC POLICY.
Cr. 1 to 6 each time elected; maximum total 15 credits. F.W.S.

698. ADVANCED TOPICS.
Cr. 1 to 3 each time elected. F.W.S.
Prerequisite: Permission of instructor.
Current topics in economic theory and applied economics. Offerings each quarter will be selected from the following list:
A. Capital and Growth. Sengupta.
C. Consumption Economics. Holdren.
E. Standards of Living. Hoyt.

699. RESEARCH.
*A. Agricultural Economics.
B. Economics.

*Offered by the College of Agriculture. Courses not marked by an asterisk are offered by the College of Sciences and Humanities.
EDUCATION
Virgil S. Lagomarcino, Dean


Undergraduate Study

Two undergraduate programs, elementary education and industrial education, leading to the degree Bachelor of Science are described in the College of Education, Curricula.

Other undergraduate curricula leading to the degree Bachelor of Science and to certification to teach nursery school-kindergarten or secondary school are listed under Curricula of the college in which the area of teaching specialization is administered and also under College of Education.

The following undergraduate courses in the professional sequence are required of all students seeking recommendations to teach in secondary schools: Educ. 204, 305A, 305B, 426, Psych. 230, 333, special methods and student teaching in the area of specialization. Students seeking certification in elementary education or nursery-kindergarten must take Educ. 204, 305B, Psych. 230, 333, methods and student teaching in the area of specialization.

I. Ed. 216, 316, and 317, plus five credits from 490, 570, 571 or 590 and Educ. 501 will meet the minimum requirements of the State Department of Public Instruction for the teaching of safety and driver education.

Graduate Study

The College of Education offers major work for the degrees Master of Science, Master of Education and Doctor of Philosophy in Education and minor work to students taking major work in other departments. Areas of specialization are adult education, educational administration, higher education, evaluation, extension education, guidance and counseling, industrial education, vocational-technical education, and philosophy of 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.

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 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

Courses in Education

204. FOUNDATIONS OF AMERICAN EDUCATION. (3-0) Cr. 3. F.W.S.SI.SSI.
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.SI.SSI.
B. (0-2) Cr. 1. F.W.S.SI.
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 THE ELEMENTARY SCHOOLS. (Music 365) See Music.


417X. OBSERVATION AND SUPERVISED TEACHING. Cr. 3-12. F.W.S.
Prerequisite: 305. course in special methods. Observation and supervised teaching in public schools and junior college

417Y. OBSERVATION AND SUPERVISED TEACHING, COLLEGE OF SCIENCES AND HUMANITIES. (D.St. 417) See Distributed Studies.

417Z. SUPERVISED TEACHING IN PHYSICAL EDUCATION IN THE SECONDARY SCHOOL. (P.E.W. 417) See Physical Education for Women.

418Y. SUPERVISED TEACHING IN PHYSICAL EDUCATION IN THE ELEMENTARY SCHOOL. (P.E.W. 418) See Physical Education for Women.

418Z. SUPERVISED TEACHING IN ART. (A.A. 418) See Applied Art.

419Y. SUPERVISED TEACHING IN ART. (A.A. 419) See Applied Art.

426. PRINCIPLES OF SECONDARY EDUCATION. (3-0) Cr. 3. F.W.S.SI.
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) 3 Cr. F.
Prerequisite: 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 5. F.W.S.
Prerequisite: 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

338 Courses and Programs

495. THE TEACHING OF SPEECH. (Sp. 495) See English and Speech.

496. METHODS OF TEACHING SOCIAL STUDIES. (D.St. 496) See Distributed Studies.

COURSES PRIMARILY FOR GRADUATE STUDENTS, major or minor, open to qualified undergraduates

Courses in Education

501. SOURCES, SELECTION, DESIGN AND PREPARATION OF INSTRUCTIONAL MEDIA. (2-2) Cr. 3. F.
Organization of instructional resources centers. Analysis of current research in effectiveness of teaching with instructional media.

502. TECHNIQUES OF TEACHING WITH INSTRUCTIONAL MEDIA. (2-2) Cr. 3. W.
Scripting and producing projected materials for classroom instruction. Implementation of research in development of effective projected materials.

503. TEACHING WITH MEDIA SYSTEMS. (2-2) Cr. 3. S.
Emphasis upon scripting, programming and implementing multi-media presentations for the classroom.

515. EVALUATION OF EDUCATIONAL OUTCOMES. (0-2) Cr. 2. W.S.S. Howe.
Prerequisite: 15 credits in education.
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 PRE-PROFESSIONAL LABORATORY EXPERIENCES. (3-0) Cr. 3. S. Schoeke.
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; continuous evaluation throughout the program.

530. PRINCIPLES AND PRACTICES OF GUIDANCE. (3-0) Cr. 3. W.S.S. Howe.
Prerequisite: 15 credits in Education and Psychology, including Educ. 426, Psych. 333. Bryan, Hopper.
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) Cr. 2 or 3. F.W.SS.
Prerequisite: 530, Psych. 440. Bryan, 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 and utilizing sources of information, and for collecting, analyzing, recording and maintaining data about individual pupils.

532. GUIDANCE SERVICES IN THE ELEMENTARY SCHOOL. (3-0) Cr. 3. W.S.S.
Prerequisite: Educ. 530.
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.S.; 533B: W.S.S.; 533C: W.S.S.
Prerequisite: 533A: 530; 533B: 533A; 533C: 532, 533A.

534. ADMINISTRATION OF THE GUIDANCE SERVICES. (2 or 3-0) Cr. 2 or 3. F.S.S.
Prerequisite: 530. Bryan, Hopper.
Administrative principles and practices in organizing and implementing the guidance services.

535. GROUP PROCEDURES IN GUIDANCE. (3-0) Cr. 3. S.S.
Prerequisite: 533, permission of instructor. Hopper.
Methods for organizing, maintaining, conducting and evaluating group counseling sessions.

536. ADULT EDUCATION. (1 or 2-3) Cr. 2 or 3. F.
Prerequisite: 15 credits in education. Holmes.
Philosophy and need for continuing education in a democratic society. Survey of current trends with emphasis upon adult education 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.S.
Prerequisite: 15 credits in education or permission of instructor. Holmes.
Principles and practices in 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 to 4-0) Cr. 2 to 4. F. S.S.
Prerequisite: 15 credits in education. Manatt, Engel.
Philosophy and purposes of education in a demo-
541. OCCUPATIONAL INFORMATION.
(3-0) Cr. 3. W.SS.
Prerequisite: 15 credits in education and psychology. Bryan, Canute, Hopper.
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. EDUCATIONAL STATISTICS.
(3-0) Cr. 3 each, F.W.SSI.SSI.
Prerequisite: 552A: 15 credits in education; 552B: 552A.
Students without credit in college mathematics must either enroll in a required non-credit four-hour laboratory accompanying 552, or have concurrent enrollment in an approved college mathematics course before enrollment in 552.
Statistical concepts and procedures for teachers, school administrators, and research workers.

555. ORGANIZATION AND ADMINISTRATION OF THE JUNIOR HIGH SCHOOL.
(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 educational theory. Responsibilities of the junior high school principal for scheduling, selection, and leadership of teaching personnel; records and reports; extra-curricular 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.
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. M. Brown.
A survey course including historical development, institutional governance, multiplication and diversity of colleges, administrative structure, organization, trends and issues. Prerequisite for other courses in higher education.

561. METHODS OF COLLEGE TEACHING.
(2 or 3-0) Cr. 2 or 3. F.S.
Prerequisite: 560. Kizer.
Basic educational theory and methods, abilities essential to effective teaching.

562. CURRICULUM AND INSTRUCTION IN HIGHER EDUCATION.
(3-0) Cr. 3. W.SSII.
Issues, trends and principles in curriculum development; experimental programs, interrelationship of general and specialized education, liberal education, professional education.

563. COLLEGE PERSONNEL POLICIES AND PRACTICES.
(3-0) Cr. 3. S.SSII.
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 community colleges. In-service development, salaries, fringe benefits, promotion, tenure, retirement and recruitment policies will also be discussed.
564. STUDENT PERSONNEL SERVICES IN COMMUNITY COLLEGES.
(3-0) Cr. 3 W.S.S.
Consideration of counseling service, financial aid, admission policies, student accounting procedures, and disciplinary practices. Emphasis upon trends in the community college programs.

565. ORGANIZATION AND ADMINISTRATION OF STUDENT PERSONNEL SERVICES IN COMMUNITY COLLEGES.
(3-0) Cr. 3 S.S.S.
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 W.
Prerequisite: 536. Lawrence
Principles and procedures in identifying and appraising program opportunities in adult education. Emphasis will be upon involvement of participants and integration of information in selecting program objectives.

575. FUNDAMENTALS OF SCHOOL LAW.
(3-0) Cr. 3 S.S.S.
Prerequisite: 541, 543. Engle, Manatt
Fundamentals and principles of law as related to the state and education, reorganization, liberty, board procedures, pupil regulation, conditions of employment.

584A, 584B. HISTORY OF EDUCATION.
(2 or 3-0) Cr. 3. 584A: W; 584B: S.
Kizer, Smith.
584A History of European Education Educational practices and institutions in ancient Greece and Rome, medieval educational patterns, rise of universities, impact of the Renaissance, Reformation, 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 practices, influences from Enlightenment, Jacksonian democracy and the rise of tax support and state supervision, response to industrialization; educational reform movements, twentieth century developments and trends.

585. COMPARATIVE EDUCATION I: EUROPE AND THE ENGLISH SPEAKING COUNTRIES.
(3-0) Cr. 3. S.S.
Smith.
Development, principles, and uses of comparative education, comparative analysis of selected educational systems, practices, objectives, and problems, specific countries treated will vary from time to time.

590. SPECIAL TOPICS.
Cr. 1 to 5 F.W.S.
Prerequisite: 15 credits in education.
A. Agricultural Education Bundy.
B. Adult Education Bundy, Holmes.
C. Secondary Education Manatt, Schoerke, Dilts.

COURSES FOR GRADUATE STUDENTS, major or minor

Courses in Education

601. PHILOSOPHY OF EDUCATION.
(3-0) Cr. 3 F.S.S.II.
Prerequisite: 15 credits of graduate work in education. Kizer.
Philosophical traditions of the ancient and medieval world, traditions of the modern world. Analysis and classification of contemporary American educational theories and philosophies.

602. CURRICULUM CONSTRUCTION.
(3-0) Cr. 3 W. S.S.
Prerequisite: 15 credits of graduate work in education. Dilts.
An analysis of curriculum theories and principles of curriculum construction. Survey of curriculum trends, promising practices and social-cultural factors affecting the curriculum.
663. PHILOSOPHICAL IDEAS IN AMERICAN EDUCATION.
(3-0) Cr. 3. S. SS.
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.
(0-1 to 3-0) Cr. 1-3. F.W.S.
A Agricultural Education
B History of Education
C Philosophy of Education
D Guidance
E Educational Administration
F Higher Education
G Community College
H Industrial Education
J Adult Education
K Research

624. RESEARCH METHODS IN EDUCATION.
(3-0) Cr. 3. S.SSI.
Prerequisite: 15 credits in education. Howe.
Adaptation of research techniques to problems in education. Primarily for students preparing to write theses

641. ADMINISTRATION PROBLEMS.
(3-0) Cr. 3. F. Alt. SSI. Offered 1970.
Engel.
A case study approach to problems in educational administration. Focuses on the development of competencies for dealing with actual situations

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.
Dilts, Masse, 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.
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

676. DUTIES OF SCHOOL PRINCIPALS.
(2 or 3-0) Cr. 2 or 3. S.
Prerequisite: 541. Manatt.
Elementary and secondary school organization and administration, schedule making, management of pupil organizations, evaluation of pupil growth. Evaluation of the total program of the community school through surveys, check lists, scales and reports

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

680. THE TEACHING-LEARNING PROCESS IN ADULT EDUCATION.
(3-0) Cr. 3. S.
Prerequisite: 570. Lawrence.
Inquiry 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

690. RESEARCH.
Cr. var. F.W.S. Brown, Bryan, Dilts, Engel, Hart, Holmes, Howe, Kizer, Lagomarcino, Lawrence, Manatt, Masse, Netusil, Schloerke, Smith.

COURSES PRIMARILY FOR UNDERGRADUATE STUDENTS

Courses in Agricultural Education

211. OBSERVATION AND SURVEY OF PROGRAM OF EDUCATION IN AGRICULTURE.
(Ag. Ed. 211) See Agricultural Education

321. PLANNING AND EVALUATING THE PROGRAM IN VOCATIONAL AGRICULTURE.
(Ag. Ed. 321) See Agricultural Education

423. METHODS OF TEACHING VOCATIONAL AGRICULTURE IN HIGH SCHOOL.
(Ag. Ed. 423) See Agricultural Education

424. YOUNG FARMER AND ADULT EDUCATION IN AGRICULTURE.
(Ag. Ed. 424) See Agricultural Education

425. OBSERVATION AND SUPERVISED TEACHING IN AGRICULTURE.
(Ag. Ed. 425) See Agricultural Education

490A SPECIAL PROBLEMS IN AGRICULTURAL EDUCATION.
(Ag. Ed. 490A) See Agricultural Education

COURSES PRIMARILY FOR GRADUATE STUDENTS, major or minor, open to qualified undergraduates

Courses in Agricultural Education

520. INSTRUCTIONAL TECHNIQUES AND MATERIALS IN AGRICULTURAL EDUCATION.
(Ag. Ed. 520) See Agricultural Education

538. POST HIGH SCHOOL EDUCATION IN AGRICULTURE.
(Ag. Ed. 538) See Agricultural Education

Education 341
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539. FARMING PROGRAMS AND EMPLOYMENT EXPERIENCE IN VOCATIONAL AGRICULTURE.
   (Ag. Ed. 539) See Agricultural Education.

540. EDUCATIONAL IMPLICATIONS OF OCCUPATIONAL ADJUSTMENT IN AGRICULTURE.
   (Ag. Ed. 540) See Agricultural Education.

590A. SPECIAL TOPICS IN AGRICULTURAL EDUCATION.
   (Ag. Ed. 590A) See Agricultural Education.

593A. WORKSHOP IN AGRICULTURAL EDUCATION.
   (Ag. Ed. 593A) See Agricultural Education.

COURSES FOR GRADUATE STUDENTS, major or minor

Courses in Agricultural Education

604. THE COMMUNITY SCHOOL PROGRAM OF AGRICULTURAL EDUCATION.
   (Ag. Ed. 604) See Agricultural Education.

690. RESEARCH.
   (Ag. Ed. 690) See Agricultural Education.

COURSES PRIMARILY FOR UNDERGRADUATE STUDENTS

Courses in Elementary Education

100. FRESHMAN ORIENTATION.
   Cr. R. F.
   Opportunities in elementary education, program planning, and personal development. Required of all freshmen majoring in elementary education.

200. SOPHOMORE ORIENTATION.
   Cr. R. F.
   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.
   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.

344. PRINCIPLES OF TEACHING IN THE ELEMENTARY SCHOOL.
   (2-0) Cr. 2. F.W.S.SSI.
   Prerequisite: Educ. 204, Psych. 333.
   Basic dimensions of teaching methods for elementary grades. Admission to the teacher education program must be completed during the quarter. Concurrent public school participation is required.

375. THE TEACHING OF READING.
   (5-0) Cr. 5. F.W.S.SSI.
   Prerequisite: 344.
   A study of the developmental reading program in the elementary school. Historical development, reading skills, materials, ability levels, evaluation, reading in the content areas, current controversies.

445. ELEMENTARY EDUCATION METHODS I.
   (4-0) Cr. 4. F.W.S.SSI.
   Prerequisite: 344.
   Essential procedures in teaching language arts and social studies in the elementary grades.

446. ELEMENTARY EDUCATION METHODS II.
   (4-0) Cr. 4. F.W.S.SSI.
   Prerequisite: 344.
   Essential procedures in teaching mathematics and science in the elementary grades.

450. THE SCHOOL AND THE DISADVANTAGED LEARNER.
   (3-0) Cr. 3. F. SSI.
   Prerequisite: Psych. 333.
   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. SSI.
   Prerequisite: El. Ed. 450, Psych. 333.
   An introduction to the learning problems of the disadvantaged child. Techniques for assessing and teaching strategies for the regular classroom teacher.

452. PRACTICUM—FIELD EXPERIENCE.
   (0-36) Cr. 6-12. F.W.S.SSI.
   Prerequisite: 451, consent of instructor.
   Field experience and practicum in working with disadvantaged children and youth. The experiences are designed for each individual student, but include study tours, working with community agencies, and teaching in disadvantaged schools.

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: 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: 445, 446, cumulative grade point average of 2.3. reservation required.
   Experience in teaching in the intermediate grades.
COURSES PRIMARILY FOR UNDERGRADUATE STUDENTS

Courses in Home Economics Education

406. OBSERVATION AND METHODS OF TEACHING HOME ECONOMICS. (H. Ed. 406) See Home Economics Education.
407. SUPERVISED TEACHING IN HOME ECONOMICS. (H. Ed. 407) See Home Economics Education.
410. PLANNING AND EVALUATING THE HOME ECONOMICS PROGRAM. (H. Ed. 410) See Home Economics Education.

415. PRINCIPLES OF EDUCATION FOR DIETITIANS. (H. Ed. 415) See Home Economics Education.
417. SUPERVISED EXPERIENCES IN HOME ECONOMICS EDUCATION. (H. Ed. 417) See Home Economics Education.
490. SPECIAL PROBLEMS. (H. Ed. 490) See Home Economics Education.

COURSES PRIMARILY FOR GRADUATE STUDENTS, major or minor, open to qualified undergraduates

Courses in Home Economics Education

500. SHORT COURSE. (H. Ed. 500) See Home Economics Education.
505. WORKSHOP. (H. Ed. 505) See Home Economics Education.

507. TRENDS IN TEACHING HOME ECONOMICS. (H. Ed. 507) See Home Economics Education.
590. SPECIAL TOPICS. (H. Ed. 590) See Home Economics Education.

COURSES FOR GRADUATE STUDENTS, major or minor

Courses in Home Economics Education

605. HOME ECONOMICS CURRICULA. (H. Ed. 605) See Home Economics Education.
606. EDUCATIONAL LEADERSHIP AND SUPERVISION IN HOME ECONOMICS. (H. Ed. 606) See Home Economics Education.
609. ADULT EDUCATION IN FAMILY LIFE. (H. Ed. 609) See Home Economics Education.
610. SEMINAR. (H. Ed. 610) See Home Economics Education.

611. DESIGN AND PHILOSOPHY OF RESEARCH IN HOME ECONOMICS EDUCATION. (H. Ed. 611) See Home Economics Education.
612. EVALUATION IN HOME ECONOMICS. (H. Ed. 612) See Home Economics Education.
614. RESEARCH. (H. Ed. 614) See Home Economics Education.

COURSE FOR NONCOLLEGIATE STUDENTS

Course in Industrial Education

18. AUTOMOBILE DRIVING. (0-2) Cr. 0. F.W.S. SS.

For those learning to drive an automobile. See Fees and Expenses.

COURSES PRIMARILY FOR UNDERGRADUATE STUDENTS

Courses in Industrial Education

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.
Qualifications, opportunities, preparation and duties of workers in industrial arts, vocational and industrial education and industry.

120. DRAFTING FOR AGRICULTURAL STUDENTS. (0-6) Cr. 3. F. W. S.
Basic techniques and skills in drafting and their application to the problems of agricultural students.

121. DRAFTING I. (2-4) Cr. 3. F.
Designed for industrial education teachers and agricultural teachers. Exploration of the drafting area, including lettering; principles and fundamentals of drafting, including techniques, care
and use of equipment, sketching, orthographic projection, pictorial drawing, drawing reproduction, topographical drafting and architectural drafting.

122. DRAFTING II.
(2-4) Cr. 3. W.
Prerequisite: 121.
Continuation of Ed 121. Emphasis on detail and assembly drawing, fasteners, dimensioning and surface development.

123. DRAFTING III.
(2-4) Cr. 3. S.
Prerequisite: 122.
This course is a continuation of 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: 105, 106; 154 or E. Gr. 131.
Basic principles and practices involved in the use of power woodworking machines and their application to furniture and cabinet 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. W. S.
Application of fundamental principles of design in planning of industrial arts projects. Field trips to industries, museums, etc.

230. ORNAMENTAL METAL DESIGN AND PROCESSES.
(0-6) Cr. 3. W.
Principles and practices involved in the use of ferrous and non-ferrous 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.

236. MACHINE METALS I.
(2-4) Cr. 3. F. W. S.
Prerequisite: 234.
Introductory course in general machine shop practice on the engine lathe and related machine tools, giving fundamental information and experience in processes and operations as applied to industrial education.

240. CRAFTS.
(0-6) Cr. 3. W.
Craft materials and their application to industrial arts, shopwork, principles and techniques of crafts suitable for industrial arts classes, such as plastics, leather, gem cutting, etc.

251. ELECTRICITY I.
(0-6) Cr. 3. F. W. S.
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.
Prerequisite: 251.
Fundamental principles and practices in the teaching of alternating current electricity in industrial education. Practical problems in power distribution, residential wiring and use of test equipment. The development of experiments, projects and teaching aids for the secondary school industrial education electricity program.

260. INTRODUCTION TO POWER MECHANICS.
(3-0) Cr. 3.
A brief study of the sources of power, application of power, power-producing devices, research, and development of power.

261. FUNDAMENTALS OF INTERNAL COMBUSTION ENGINES.
(2-4) Cr. 3.
Prerequisite: 260.
Familiarization with reciprocating and reaction engines with emphasis on 2 and 4-stroke cycle reciprocating engines. Use of tools and equipment for small engine overhaul and tune-up.

262. INTRODUCTION TO THE AUTOMOBILE.
(3-0) Cr. 3.
Prerequisite: 260.
General introduction to the automotive production and service industry, and the automobile itself including engine, chassis, and body.

308. MODERN MATERIALS, DESIGN AND CONSTRUCTION.
(6-6) 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 SHOP SAFETY EDUCATION.
(3-0) Cr. 3. F. S.
Prerequisite: Junior classification.
Analysis of accidents and accident prevention in the school shop. Methods of initiating an effective safety program. First aid instruction.

316. THEORY AND PRINCIPLES OF DRIVER EDUCATION.
(3-2) Cr. 4. W.
Prerequisite: 216, Iowa driver's license. Permission of instructor.
Source materials, methods, policies and procedures, and psychological aspects of driver education, techniques including psychological measurement and interpretation.

317. PRACTICES OF DRIVER EDUCATION.
Cr. 1 to 3 each time elected, total no more than 4. F.W.S.S.
Prerequisite: 316. Iowa driver's license, permission of instructor.
Organization of, and experience with, both classroom and behind-the-wheel phases of driver education; lesson plans, films, scheduling and testing techniques.

324. TEACHING SECONDARY SCHOOL DRAWING.
(0-6) Cr. 3. S.
Prerequisite: 6 credits of drawing.
Organization of subject matter, methods, teaching aids, and evaluation as applied to the teaching of drawing in high schools.

336. MACHINE METALS II.
(2-4) Cr. 3. F. W. S.
Prerequisite: 256.
Advanced theory and laboratory practice in the setup and operation of machine tools as applied to industrial education.

352. ELECTRICITY III.
(0-6) Cr. 3. W.
350. 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.

351. SHIP PLANNING AND ORGANIZATION. (3-0) Cr. 3. S.
Planning of school shops, selection and location of equipment, estimate of cost. Trips to secondary schools.

352. 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.

353. OBSERVATION AND SUPERVISED STUDENT TEACHING IN INDUSTRIAL EDUCATION. Cr. 3 to 12. F.W.S.
Prerequisite: 415.
Observation and supervised teaching in public schools.

354. ELECTRONICS II. (1-6) Cr. 3. F.W.S.
Prerequisite: 357.
Basic television construction, service and repair. Use of the oscilloscope, vacuum tube, ohm 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.

355. SPECIAL PROBLEMS IN INDUSTRIAL EDUCATION. Cr. 1 to 5. F.W.S.
Prerequisite: Junior classification, quality point average of 2.5 or more for two preceding quarters.
H-Honors Program
G-Technical Training
S-Safety

COURSES PRIMARILY FOR GRADUATE STUDENTS, major or minor, open to qualified undergraduates

Courses in Industrial Education

501. WOOD COMPOSITION MATERIALS. (1-5) Cr. 3. F. Alt. SS. Offered 1971.
Prerequisite: 205 or permission of instructor. Principles of small scale production of particleboard, hardboard, and wood flour-molded products through hot and cold molding methods.

502. TECHNIQUE OF TEACHING VOCATIONAL AND TECHNICAL EDUCATION. (3-0) Cr. 3. F.W.S.
Teaching processes, methods of presentation and testing, lesson planning and organization of instruction.

503. FOUNDATIONS OF VOCATIONAL AND TECHNICAL EDUCATION. (3-0) Cr. 3. F.W.S. Carver.

504. TRENDS IN VOCATIONAL-TECHNICAL EDUCATION. (3-0) Cr. 3. S.S.
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 the following curriculum, qualifications and training of instructors, administration of programs. Requirements for program certification, and the developing ratio of technical, related and general education within the curriculum.

505. PROBLEMS IN INDUSTRIAL EDUCATION. (3-0) Cr. 3. S.
Prerequisite: 415.
Initiating programs, program organization and development, purchasing materials and equipment, facility planning and utilization, writing specifications, program evaluation and other related problems.

506. OCCUPATIONAL ANALYSIS AND COURSE CONSTRUCTION. (3-0) Cr. 3. F.W.S.
Course of study development based on occupational analysis. Compilation, arrangement and limitations of instructional materials.

524. CONFERENCE LEADING TECHNIQUES. (6-0) Cr. 3. S.S.
COURSES FOR GRADUATE STUDENTS, major or minor

Courses in Industrial Education

652. EVALUATION IN INDUSTRIAL EDUCATION. (2 or 30) Cr. 2 or 3 SS. Prerequisite: 15 credits in industrial education. Carver, Weede. Developing basic concepts. Techniques for evaluating student personnel, facilities, programs, staff, and other educational resources

655. ADMINISTRATION AND SUPERVISION OF INDUSTRIAL EDUCATION. (3-0) Cr. 2 or 3 SS. Carver. Administration, supervision, curriculum development, selection of staff, and public relations. Evaluating administrative and supervisory efforts, program modification, field trips to schools and industries.

656. TEACHING MULTIPLE ACTIVITIES IN INDUSTRIAL EDUCATION. (3-0) Cr. 3. Prerequisite: 15 credits in industrial education. Carver, Parks. A study of the multiple activity concept of teaching shop classes, history, development and trends; organization and operation, projects and units of instruction, planning and maintaining facilities.

657. CURRICULUM DEVELOPMENT IN INDUSTRIAL EDUCATION. (3-0) Cr. 3 SS. Prerequisite: 15 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.

658. MATERIALS, PRODUCTS AND PROCESSES OF INDUSTRY. (3-0) Cr. 3. S. SS. 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.

659. MATERIALS, PRODUCTS AND PROCESSES OF INDUSTRY. (3-0) Cr. 3. S. SS. 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.

660. WORKSHOP IN INDUSTRIAL EDUCATION. Cr. 1 to 5. SS. Prerequisite: 15 credits in industrial education. Carver, Parks, Weede.
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 major work for the degrees Master of Science and Doctor of Philosophy 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 and no substitute in lieu of a foreign language requirement for either the degree Master of Science or the degree Master of Engineering. The department should be consulted for the foreign language requirement for the degree Doctor of Philosophy.

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 com-
plication 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.

211. **ELECTRIC CIRCUITS I.**
   (4-0) Cr. 4. W.S.
   Prerequisite: Phys. 223, credit or classification in Math. 213.
   Electric circuits as signal processors, introduction to linear network analysis.

231. **ELECTRICAL INSTRUMENTATION AND EXPERIMENTATION I.**
   (1-2) Cr. 2. W.S.
   Prerequisite: Credit or classification in 211.
   Systems for measurement of electrical quantities—voltage, current, power, time, impedance.

300. **SEMINAR.**
   (1-0) Cr. R.S.
   Prerequisite: Junior classification.

301, 302, 303. **ELECTRIC CIRCUITS II, III.**
   AND IV.
   301: (3-0) Cr. 3. F.S.; 302: (3-0) Cr. 3. F.W.;
   303: (3-2) Cr. 4. W.S.
   Prerequisite: 301; 211, credit or classification in 231, credit or classification in Math. 321;
   302: 301, credit or classification in Math. 322 and 232; 303: 302.
   Transient and steady state analysis of electric circuits using Laplace transform methods of analysis. Network equations and theorems, polyphase circuits, and two-port networks.

313. **ELECTRIC AND MAGNETIC FIELD THEORY I.**
   (4-0) Cr. 4. F.S.
   Prerequisite: Math. 213, Phys. 223.
   Vector analysis. Principles of electrostatic fields.

314. **ELECTRIC AND MAGNETIC FIELD THEORY II.**
   (4-0) Cr. 4. F.W.
   Prerequisite: 313.

315. **TELEVISION FUNDAMENTALS.**
   (3-0) Cr. 3. F.W.
   Prerequisite: Sp. 301.

317. **ELECTROMECHANICAL DEVICES.**
   (3-2) Cr. 4. W.S.
   Prerequisite: 314, 302.
   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 or 3 each. W.S.
   Prerequisite: 341: Phys. 223, Math. 112; 342: 341.
   Principles of direct and alternating current circuits and machines. For architectural, ceramic, chemical, and industrial engineers.

351. **ELECTRIC MACHINERY.**
   (3-2) Cr. 4. F.S.
   Prerequisite: 317, classification in 303.
   Analysis of rotating electric machinery with emphasis on applications.

374, 375, 376. **ELECTRONICS ENGINEERING.**
   (3-3) Cr. 4 each. 374: F.W.; 375: W.S.; 376: F.S.
   Prerequisite: 374: credit or classification in 302; 375: 374, credit or classification in 303; 376: 375, Phys. 302.
   Linear, piecewise-linear and large-signal modeling of selected electronic devices. Analysis of electronic circuit topics such as biasing, amplification, application of circuit theorems, frequency characteristics, distortion, power dissipation, feedback effects, oscillation, switching. Introduction to transistor physical electronics.

410. **INTRODUCTION TO SWITCHING THEORY.**
   (Com.S. 410) (3-0) Cr. 3. F.
   Axiomatic development of Boolean algebra. Combinational circuits using AND, OR, NOT and other logic elements, truth tables, maps, minimization techniques. Introduction to asynchronous...
411, 412. PRINCIPLES OF COMPUTER DESIGN. (Com.S. 411, 412) (3-2) Cr. 4.; (3-0) Cr. 3. W. S.

417, 418. INTRODUCTION TO SYSTEMS ANALYSIS.
417: (3-0) Cr. 3. F; 418: (3-0) Cr. 3. W. S.
Prerequisite: 417: Math. 322; 418: 417.

421, 422, 423. LINES, WAVES AND RADIATION.
(3-3) Cr. 4 each. Yr.
Prerequisite: 421: 303, Math. 410; 422: 421; 423: 422.
Transmission of electric energy via lines, waves and antennas. Microwave applications.

426. PULSE AND DIGITAL CIRCUITS.
(3-3) Cr. 4. F. S.
Prerequisite: 376.
The diode and active devices in switching circuits. Use of the transfer function and the Laplace transform in circuit analysis. Basic logic elements.

428. ELECTRICAL PROPERTIES OF MATERIALS.
(4-0) Cr. 4. W.
Prerequisite: 376, Phys. 303.
Electrical properties of metals, semiconductors, insulators, and magnetic materials as utilized in device applications such as lasers and integrated circuits.

431. ELECTRICAL ENERGY SOURCES.
(3-0) Cr. 3.
Prerequisite: 302 or 342 or 441, Phys. 303.
Specialized and unconventional sources of electrical energy such as: photovoltaic generators (solar cells), thermionic converters, and magnetohydrodynamic generators. Other energy conversion schemes.

441, 442. INTRODUCTION TO CIRCUITS AND INSTRUMENTS.
(3-2) Cr. 4 each. 441: F. W.; 442: W. S.
Prerequisite: 441: Phys. 225, credit or classification in Math. 213; 442: 441.
441. Transient and steady state behavior of circuits. Use of the transfer function and the phasor transform in circuit analysis. Basic instruments. 442: Frequency response, bridge circuits, magnetically coupled circuits, transformers, periodic driving functions.

445, 446. ELECTRONIC CIRCUITS, INSTRUMENTS, AND SYSTEMS.
445: (3-3) Cr. 4. W. S.; 446: (4-0) Cr. 4. S.
Prerequisite: 445: 342 or 441; 446: 445.
445. Basic electronic circuits. 446. Electronic instrumentation and systems. Credit will not be allowed for both the 374, 375, 376 and the 445, 446 sequences.

447. ELECTRONIC CIRCUITS AND SYSTEMS FOR BIOMEDICAL ENGINEERING.
(3-3) Cr. 4. S.
Prerequisite: 445.
Electronic instrumentation and systems for biomedical engineering. (This course is designed primarily for life science students in the biomedical engineering program.)

451. INTRODUCTION TO ELECTRIC MACHINERY.
(3-2) Cr. 4. F.S.
Prerequisite: 442.
Three phase circuit analysis. Power transformers. Basic principles of operation, design, and control of AC machines, induction machines, synchronous machines and single phase machines.

452. ELECTRIC POWER MACHINERY.
(3-3) Cr. 4. S.
Prerequisite: 351 or 451.
Analysis of machine transients. Stability and control of multiphase and single phase machines.

465. INTRODUCTION TO ENERGY SYSTEMS.
(4-0) Cr. 4. F.
Prerequisite: 303, 351.
Electric energy requirements, structure of energy systems, energy resources, structure of bulk conversion schemes, thermal generation, hydro generation, future generation, economics of generation, structure of transmission systems, operation.

466, 467. POWER SYSTEM ANALYSIS.
466: (4-0) Cr. 4. W.; 467: (3-3) Cr. 4. S.
Prerequisite: 466: 465; 467: 466.
AC and DC transmission, transmission lines, generalized and graphical calculations, network analysis, load flow, system faults and fault calculations, transients and system insulation stability, economic operation.

471. BASIC BIOMEDICAL ELECTRONICS.
(3-0) Cr. 3. S.
Prerequisites: Math. 102; 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 minor credit in biomedical engineering.

475. ANALOG SIMULATION TECHNIQUES.
(0-3) Cr. 1.
Prerequisite: 417.
Laboratory dealing with applications of analog simulation of control systems.

498. SPECIAL PROBLEMS.
Cr. 1 to 5 as arranged. F.W.S.
Prerequisite: Senior classification in E.E. Investigation of an approved topic commensurate with the student's prerequisites, interest and ability.

COURSES PRIMARILY FOR GRADUATE STUDENTS, major or minor, open to qualified undergraduates

501, 502, 503. ANALYSIS OF LINEAR SYSTEMS.
(3-0) Cr. 3 each. F.W.S.
501. Analysis of linear systems by operational methods. Introduction to systems with feedback.
507. SEMICONDUCTOR DEVICE THEORY.
(3-0) Cr. 3. S.
Prerequisite: 376 and Phys. 302.
P-n junction theory beginning with continuity and transport equations, characteristics of p-n junctions, junction transistor theory and characteristics, transistor parameter models, junction field-effect transistors.

508. SEMICONDUCTOR DEVICE APPLICATIONS.
(3-0) Cr. 3. W.
Prerequisite: 376 or 445.
Special topics in semiconductor circuits biasing and temperature stability, problems in amplifier and active filter design using discrete and integrated circuits, oscillators, switches, noise problems.

509. INTEGRATED AND HYBRID CIRCUITS.
(3-0) Cr. 3. S.
Prerequisite: 507 or Phys. 513.
MOS and bipolar integrated circuits design principles and fabrication. Design compromises, hybrid circuits. Topics in application design: Gunn effect, varactor multipliers, avalanche mode devices, Schottky barrier devices.

518, 519, 520. ELECTRIC AND MAGNETIC PROPERTIES OF MATERIALS.
(3-0) Cr. 3 each. F.W.S.
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.
Prerequisite: 314, Phys. 303.
Ionization processes, diffusion and recombination, electron attachment; behavior of charged particles in fields; mobility; self-sustained processes; breakdown, glow; arcs and coronas, microwave breakdown; plasma oscillations, plasma interaction with electromagnetic waves, applications.

527. COMMUNICATION SYSTEMS ANALYSIS AND DESIGN.
(3-0) Cr. 4. S.
Prerequisite: 418.
Introduction to information theory. Modulation techniques and analysis and design of communication links from a systems viewpoint.

531. NETWORKS AND LINEAR GRAPHS.
(3-0) Cr. 3. F.
Prerequisite: 501.

532. SYNTHESIS OF ELECTRIC NETWORKS.
(3-0) Cr. 3.
Prerequisite: 303.
Necessary and sufficient conditions and synthesis methods for realization of passive driving point functions.

533. SYNTHESIS OF ELECTRIC NETWORKS.
(3-0) Cr. 3.
Prerequisite: 532.
Approximations useful in network synthesis, synthesis of passive two-port networks.

534. SYNTHESIS OF ELECTRIC NETWORKS.
(3-0) Cr. 3.
Prerequisite: 533.
Properties of networks containing active elements and methods for synthesis of such networks.

539. MATRIX NETWORK ANALYSIS.
(3-0) Cr. 3. F.
Prerequisite: 303 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. F. Offered 1970.
Prerequisite: 467.
Calculation of sequence impedances, analysis of unbalanced systems and unbalanced conditions.

542. POWER SYSTEM PROTECTION.
(3-0) Cr. 3. Alt. W. Offered 1970.
Prerequisite: 541.
Criteria for fault clearing, device coordination, relaying.

543. COMPUTER SOLUTIONS FOR POWER SYSTEMS.
(3-0) Cr. 3. Alt. S. Offered 1971.
Prerequisites: 502, 541.
The study of algorithms adaptable to digital computers for load flow, fault, and stability problems.

544. DISTRIBUTION ENGINEERING.
(3-0) Cr. 3. Alt. W. Offered 1970.
Prerequisite: 467.
Distribution components, design criteria, protective device coordination, secondary networks, voltage control.

546. ECONOMIC OPERATION OF POWER SYSTEMS.
(3-0) Cr. 3. Alt. S. Offered 1970.
Prerequisite: 545.
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. S. Offered 1971.
Prerequisite: 314.
Transmission by direct current, inverter design, system simulation, parallel operation, stability considerations.

550. STATIC ELECTRIC AND MAGNETIC FIELDS.
(3-0) Cr. 3. F.
Prerequisite: 313, Math. 411.
Static electric and magnetic fields, potential theory, static fields in matter, solutions of Laplace's equation.

551. 552, 553. ELECTROMAGNETIC FIELDS.
(3-0) Cr. 3 each. W. S. F.
Prerequisite: 551: 313 or 550; 552: 551; 553: 552.

565. INFORMATION THEORY I.
(3-0) Cr. 3. F.
Prerequisite: 418.

566. INFORMATION THEORY II.
(3-0) Cr. 3. W.
Prerequisite: 565.
Codes for error detection, location and correction.
618. ADVANCED TOPICS IN ELECTRICAL MATERIALS. (3-0) Cr. 3 each time elected. 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. Prerequisite: 636; 539; 637: 636.

Need for high voltage, high fields, ionization, AC and DC corona, voltage transients, lightning and protection, insulator flashover, insulation coordination, circuit interruption, radio interference.

Dynamic performance of interconnected power systems with emphasis on stability. Topics discussed 1 Dynamic equation of a synchronous machine and its response to perturbations 2 Control equipment in a power system including voltage regulators, governors and load frequency controls 3 Representation of system components including the machine, the controls and the loads during transients 4 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. Prerequisite: 431 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

651. ADVANCED TOPICS IN ELECTROMAGNETIC THEORY. (3-0) Cr. 3 each time elected. Prerequisite: 552.
A Microwave networks and devices
B Propagation in turbulent media
C Antenna engineering

COURSES FOR GRADUATE STUDENTS, major or minor
671. BIOMEDICAL INFORMATION PROCESSING.
(3-0) Cr. 3. S.
Prerequisite: 447.
Biological signal processing including the application of computers and advanced servomechanism concepts to biological systems. Medical automation, bionics, including neuron models and recognition systems.

677, 678. NONLINEAR SYSTEMS.
(3-0) Cr. 3 each. 677: F.; 678: W.
Prerequisite: 503, 575.

684. ADVANCED SWITCHING THEORY.
(Com.S. 684) (3-0) Cr. 3.
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.

689. COMPUTER SEMINAR.
Cr. 1-3 each time elected.
Prerequisite: 586.
Various computer topics of timely interest.

691, 692. OPTIMAL CONTROL.
(3-0) Cr. 3 each, F.W.
Prerequisite: 503, 575.

699. RESEARCH.
F.W.S.

ELEMENTARY EDUCATION

For description of courses, see Education.

ENGINEERING

George R. Town, D. Engr., Dean of Engineering
Paul E. Morgan, M.S., Assistant Dean

Professors: Lawrence R. Hillyard, M.S.; Merlin L. Millett, Jr., Ph.D.
Associate Professors: Jack L. Mickle, Ph.D.; Milton L. Rogness, M.S.; Raymond A. Veline, B.S.
Assistant Professors: Paul W. Barcus, Ph.D.; John T. Jones, Ph.D.; Albert C. Miller, B.S.
Instructors: Robert A. Mohling, M.Engr.; Darryl J. Trulin, 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
114. Nature of professional work in engineering
115. Nature of various branches of engineering and some fundamental considerations in selecting a career
(1-0) Cr. R

190. SPECIAL TOPICS.
Cr. 1 to 5 each time elected.
Prerequisite: Engineering classification.
Topics pertinent to development of programs common to engineering curricula.

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. (Hist. 431A, 431B) (3-0) Cr. 3 each. 431A: F.W.; 431B: W.S.
Prerequisite: Junior classification.
431B. Emergence of modern engineering after 1700. Influences of science, society and resources upon technological development. Rise of professionalism, place of engineer in today's culture

COURSES PRIMARILY FOR GRADUATE STUDENTS, major or minor, open to qualified undergraduates

515. HISTORY OF TECHNOLOGY IN U.S. (3-0) Cr. 3. S.
Prerequisite: 431B.
Transfer of technology and science from Europe, U. S. innovations; the "American system" of manufacture and mass-production; heavy industry; scientific management

561. TECHNOLOGY IN DEVELOPING COUNTRIES. (3-0) Cr. 3. F.
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.

590. SPECIAL TOPICS IN THE HISTORY OF TECHNOLOGY. Cr. 2 to 5.
Prerequisite: Nine credits in history of technology.

ENGINEERING GRAPHICS
C. Gordon Sanders, M.A., 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.; Milton L. Rogness, M.S.
Assistant Professors: Robert O. Butler, B.S.; Paul S. DeJong, M.E.; Wayne C. Dowling, M.S.; Robert I. Duncan, B.S.; Glenn B. McConnell, B.S.; Cletus R. Mercier, B.S.; Carl J. Sayre, M.S.
Instructors: William A. Ellingson, B.S.; Gary A. Granneman, B.S.; Raman R. Nayar, B.Arch.

Undergraduate Study

The graphical language gives the engineer a professional literacy essential to all engineering work. Freehand sketching is employed extensively using orthographic and pictorial methods to teach rapid execution of shape-description problems. Familiarity with drafting standards and industrial communication drawings is developed with a minimum amount of instrument delineation. Greater emphasis is being placed upon the graphical solutions of space relationship problems with an increased recognition of the speed and accuracy of graphical methods to replace and supplement many mathematical solutions of engineering problems.

In teaching the fundamentals of engineering graphics, attention is directed not alone to the technique of drawing but even more toward the power of visualization and conceptualization. Fundamentals of engineering design are introduced to provide a vehicle for graphical presentation and at the same time stimulate creativity and initiative. An analytical approach is emphasized that will serve as a pattern of attack for the solution of any engineering problem.

COURSES PRIMARILY FOR UNDERGRADUATE STUDENTS

161. BASIC ENGINEERING GRAPHICS. (1-6) Cr. 3. F.W.S.
Freehand sketching and lettering use of drawing instruments and materials. Graphical theory in orthographic projection of points, lines, planes, and solids. Spatial geometry problems of lines and planes. Freehand and instrument drawing involving standards, sections, and conventional practices. Dimensioning for basic size specification and mating parts

162. GRAPHICAL THEORY AND APPLICATION. (1-6) Cr. 3. W.S.
Prerequisite: 161.
Theory and application of pictorial projections. Geometry of true distances, clearances, angles, sizes, and surfaces by freehand and instrumental delineation. An analytical approach to problem solution by application to spatial and vector geometry. Introduction to graphical mathematics.
205. CONCEPTUAL DESIGN.  
(1-6) Cr. 3. W.S.  
Prerequisite: 162.  
A study of the fundamental steps of design including goals, analyses, and solution configurations applied to individual problems, creative projects and case studies. Applications selected from fields of engineering determined by student interest. Familiarization with reference materials such as catalogs, standards, and hand books. Design involvement with limit sizes for mating parts, hardware, schematics, layouts, logic diagrams, nomographs, and graphical calculus.

235. ADVANCED GRAPHICAL PROBLEMS.  
(0-3 to 15) Cr. 1 to 5. S.  
Prerequisite: 162, permission or 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 Illustration. Advanced work in graphical differentiation, graphical integration, graphical derivation of empirical equations, alignment charts and nomographs.

341. ARCHITECTURAL GRAPHICS I.  
(1-6) Cr. 3. F.  

342. ARCHITECTURAL GRAPHICS II.  
(1-6) 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.  
(1-6) Cr. 3. S.  
Prerequisite: 342.  
Perspective drawing, shades and shadows. 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. Additional information concerning the journalism courses and requirements may be obtained from the Head of the Department of Journalism.

Required courses in engineering journalism include all the required courses in the engineering operations curriculum except as noted below.

The following number of credits in journalism must be included for the engineering journalism program:

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<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>
</tr>
</tbody>
</table>

A 400-level journalism course, preferably 430, may be substituted for I. 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 credit hours required for graduation in the engineering journalism program is 190 plus the professional work requirement.
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 major work for the degrees Master of Science, Master of Engineering and Doctor of Philosophy 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 degree Doctor of Philosophy.

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.I.S.S.II.
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 non-coplanar 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.

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.SSI.
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 subjected 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.SSI.SSII.
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.SSI.
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 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.SSI.
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.SSI.SSII.
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.

378. MECHANICS OF FLUIDS.
(3-2) Cr. 4. F.W.S.SSI.
Prerequisite: 345.

420. PRINCIPLES OF MECHANICS IN BIOMEDICAL ENGINEERING.
(4-0) Cr. 4. F.
Prerequisite: Phys. 111 or 221, Math. 213.
Selected topics in applied mechanics with applications in biomechanics. Includes statics and dynamics of particles and rigid bodies, concepts of stress and deformation, equations of motion for continuous media, dynamics of perfect fluids, elastic behavior of solids, viscous flow. Primarily for students majoring in one of the life sciences.

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. F.W.S.
Prerequisite: Permission of instructor.

*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

500. SPECIAL TOPICS.
Cr. 2 to 5 each time elected. As arr.

504. 505. 506. ANALYTICAL METHODS IN MECHANICS.
(3-0) Cr. 3 each. 504: F.SSI.; 505: W.SSI.; 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.
(3-0) Cr. 3. F.SSI.
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 non-circular sections. Theories of failure, membrane stresses in shells, thick walled cylinders.

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 semi-conductor 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. Alt. 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.
(2-2) Cr. 3. Alt. S.
Prerequisite: 517, Math. 321.
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.
530. INTRODUCTION TO MECHANICS OF CONTINUOUS MEDIA.
   (3-0) Cr. 3. F.SSI.
   Prerequisite: Math. 322.
   Matrices, cartesian tensors, and tensor fields, applications to the motion of a continuous medium; stress, strain and strain rate tensors, conservation laws.

535. RHEOLOGY I.
   (3-0) Cr. 3. W.
   Prerequisite: 530.
   Kinematics, velocity gradients, deformation rate and spin tensors. Objective derivative, isotropy of space, constitutive equations for non-Newtonian and anisotropic fluids. Applications Viscocometric and other simple flows.

544. MECHANICAL VIBRATIONS.
   (3-2) Cr. 4. F.SSI.
   Prerequisite: 325, 346, Math. 321.
   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, Lagrangian equations of motion, applications. Use of analog computers in analysis of vibration problems.

545. ADVANCED VIBRATION ANALYSIS.
   (3-0) Cr. 3. W.
   Prerequisite: 544, Math. 322.

547. INTRODUCTION TO RANDOM VIBRATIONS.
   (3-0) Cr. 3. Alt. S.
   Prerequisite: 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. ADVANCED ENGINEERING DYNAMICS.
   548: (4-0) Cr. 4. W.; 549: (3-0) Cr. 3. S.
   Prerequisites: 545, Math. 321.

555. LINEAR WAVE PROPAGATION.
   (3-0) Cr. 3. Alt. F.
   Prerequisite: 506, 530.
   Surfaces of discontinuity, wave-fronts, characteristics, retarded potentials; reflection and refraction, anisotropy, dispersion and damping; phase velocity and group velocity, asymptotic methods.

564. ELASTIC STABILITY.
   (3-0) Cr. 3. W.
   Prerequisite: 514 or credit or classification in 594.

567. THEORY OF PLATES AND SHELLS.
   (3-0). Cr. 3 each. 566: Alt. W.; 567: Alt. S.
   Prerequisite: 514 or credit or classification in 594.
   Thin plate analysis, three-dimensional plate problems; shells, stability and vibration of plates and shells.

569. INTRODUCTION TO LINEAR VISCOELASTICITY.
   (3-0) Cr. 3. S.
   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, 573: (3-0) Cr. 3 each. W.S.
   Prerequisite: 571: 378 or M.E. 424; 572, 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; compressible 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.

593, 594, 595. THEORY OF ELASTICITY.
   (3-0) Cr. 3 each. Yr.
   Prerequisite: 593: 324 or 325; 594: 593; 595: 594, credit or classification in Math. 411.
   Fundamental relations of plasticity; uniform and non-uniform states of stress; Airy's function; application to engineering problems.

COURSES FOR GRADUATE STUDENTS, major or minor

600. RESEARCH.
   (1-0) Cr. 1.

620. SEMINAR.

635. RHEOLOGY II.
   (3-0) Cr. 3. S.
   Prerequisite: 535.
   Finite deformations, large strains, Green's right and left strain tensors. Elastic and hyperelastic materials, strain energy function, applications.

636. ADVANCED TOPICS IN RHEOLOGY.
   (3-0) Cr. 3. F.
   Prerequisite: 635.
   Recent developments in rheology. Complex problems, detailed study of sophisticated materials, Eriksen fluids, polar media.
650. FLUID MECHANICS SEMINAR.  
(M.E. 650, Aer.E. 650)  
(1-0) 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.  
Prerequisite: 651: 571; 652: 573; 653: 530, 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 non-linear stability. 653 Turbulence. Isotropic turbulence, shear flows, jets and wakes, other recent theories.

655. NON-LINEAR WAVE PROPAGATION.  
(3-0) Cr. 3, Alt. W.

Prerequisite: 555.  
Geometry of moving surfaces. Hadamard's lemma, compatibility conditions; simple waves; ray-theory, growth of waves of finite amplitude in continua, non-linear dispersion

661. ADVANCED TOPICS IN ELASTICITY.  
(3-0) Cr. 3, Alt. F.  
Prerequisite: 595.  
Complex mapping techniques, three dimensional problems, variational and energy principles, current literature

668. PLASTICITY II.  
(3-0) Cr. 3, Alt. F.  
Prerequisite: 568.  
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

ENGINEERING SCIENCE

Glenn Murphy, Ph.D., Head of Nuclear Engineering

Assistant Professors: Paul W. Barcus, Ph.D.; Howard Bell, Ph.D.; Michael C. J. Carlson, 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 to 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 in engineering science is available to students taking major work in other departments.

Open to graduate students for minor only: 351, 352, 353, 481, 482, 483, 484, 491, 499.

COURSES PRIMARILY FOR UNDERGRADUATE STUDENTS

100. TECHNICAL LECTURE.  
(1-0) Cr R.S.

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.
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.

ENGINEERING MATERIALS.  
(3-2) Cr. 4. F.  
Prerequisite: 352.  
Thermal and electrical characteristics, polycrystalline 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.

ENGLISH AND SPEECH

Albert L. Walker, Ph.D., Chairman of Department


Associate Professors: Phillips G. Davies, Ph.D.; M. Burton Drexler, Ph.D.; Elizabeth Fuller, A.M.; Richard C. Gustafson, Ph.D.; Quentin G. Johnson, Ph.D.; Hazel E. Lipa, M.A.; John F. Speer, Ph.D.


Undergraduate Study

For the undergraduate curriculum in sciences and humanities, major in English and Speech, leading to the degree Bachelor of Science, see Sciences and Humanities, Curriculum.

Students may choose one of the following options: English, speech, telecommunicative arts.

The programs for majors in English and speech are flexible. Students can prepare, first, to teach English, speech, or drama in the secondary schools. For the University statement of requirements for teacher certification, see College of Education. Second, students can prepare for graduate study and eventual teaching in college or university. Third, students can prepare for positions in technical writing, advertising, sales and public relations, personnel, radio and television. Students can also pursue pre-medical, pre-legal, or pre-theological studies.

Students majoring in other departments or colleges may in many instances choose English, speech, or telecommunicative arts as a minor.

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. Engl. 104 and 105 are required of all undergraduates, and Sp. 211 is required in all curricula in the College of Sciences and Humanities and in most curricula of other colleges. Engl. 201 is prerequisite for most other courses in literature. Advanced instruction in oral and written 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, and a Speech Clinic for all students who wish help with individual speech problems.

The department conducts a laboratory in Developmental Reading to meet the needs of students who wish to increase their proficiency beyond the average level (see Engl. 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, 384A, 384B, 367, or 388; 354A, 354B, or 366. A major in speech is expected to include the following courses (listed under Speech and Telecommunicative Arts): 207, 305, 309, 324, 326, 334A, 336A, and 375. A program emphasizing telecommunicative arts is expected to include the following courses (listed under Speech and Telecommunicative Arts): 206, 228, 301, 302, 321, 326, 328, 400B, 400C, and Engl. 315. 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 major work for the degree Master of Arts, major in English, and minor work for students majoring in other departments. The master's degree involving a thesis, with six credits for the thesis, and the master's degree without a thesis are available. Credits must total at least 45 for either program. The decision whether a student will be permitted to plan a thesis or a non-thesis program will be reached at the time he is admitted to candidacy for the degree.

Prerequisite to major graduate work is the completion of study substantially equivalent to the undergraduate major in English at this institution.

Programs are designed to prepare students for the following:
1. Further graduate studies in language and literature.
2. Teaching at the secondary, junior college, or beginning university level. All graduate students majoring in English are required to do some teaching as part of their training for an advanced degree.
3. Professional writing and editing in such areas as imaginative literature, business, science, and technology.

Special emphases include (1) application of principles of rhetoric, linguistics, and semantics to factual and imaginative literature and to literary criticism; (2) scientific and technical writing; (3) an inquiry into the relationships between literature and science and technology.

COURSES PRIMARILY FOR UNDERGRADUATE STUDENTS

Courses in English

10A, 10B, 10C. ENGLISH FOR FOREIGN STUDENTS.
(4-0 to 8-2) Cr. 0. 10A: F.W.S.; 10B: F.W.S.; 10C: F.W.S.
Prerequisite: 10A: 10B or permission of instructor.
10A Intermediate grammar and pattern practices. 10B: Advanced composition and reading practices 10C: Intermediate vocabulary and pronunciation 10A and 10C should be taken concurrently. A two-hour laboratory is required with 10A and 10C. Classification is based on an entrance examination.

104, 105. LANGUAGE IN COMPOSITION AND READING.
(4-0) Cr. 4 each. F.W.S.SS.
Prerequisite: 105: 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 and Speech 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.
(6-2) Cr. 1 each time elected, maximum 3 credits. 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.SSII.
Prerequisite: 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 persuade 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
304B: Personalized exposition; personal, social, or scientific material with individualized expression.
366. **EUROPEAN DRAMA: THE GREEKS TO IBSEN.**
(3-0) Cr. 3. W.
Prerequisite: 201.
European dramas, Aesoplytos to Ibsen, exclusive of British drama.

367. **EUROPEAN DRAMA: IBSEN TO THE PRESENT.**
(3-0) Cr. 3. S.
Prerequisite: 201.
Realistic and naturalistic European drama since Ibsen.

368. **BRITISH DRAMA TO 1642**
EXCLUSIVE OF SHAKESPEARE.
(3-0) Cr. 3. Alt. W. Offered 1970.
Prerequisite: 201.
The medieval, Elizabethan, and Jacobean drama, reading, discussion, and criticism of representative plays.

374A, 374B. **ENGLISH LITERATURE.**
(3-0) Cr. 3 each. 374A: F.W.SSI; 374B: Alt. W. Offered 1971.
Prerequisite: 201. 374A, 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.SSSII; 375B: Alt. W. Offered 1970.
Prerequisite: 201. 375A, 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 1971.
Prerequisite: 201. 376A, 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 CORRESPONDENCE.**
(2-0) Cr. 2. W.S.
Prerequisite: 105, junior classification.
Principles which govern the writing of business letters. Types of business letters.

414. **WRITING OF REPORTS AND TECHNICAL PAPERS.**
(3-0) Cr. 3. F.W.S.SS.SSI.
Prerequisite: 105. 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.
Prerequisite: 105.
Introduction to modern grammar and linguistics; methods of grammatical analysis.

420. **DEVELOPMENT OF THE ENGLISH LANGUAGE.**
(3-0) Cr. 3. S.
Prerequisite: 9 credits in English beyond 105 or the equivalent in a foreign language.
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. **SHAKESPEARE.**
(3-0) Cr. 3 each. 464A: F.S; 464B: W.
Prerequisite: 464A: 374A; 464B: 374A.
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 Shakespearean scholarship.

476. **VICTORIAN POETRY.**
(3-0) Cr. 3. Alt. F. Offered 1969.
Prerequisite: 376A.
Selected Victorian poets with attention to later transitional figures. Aspects of the Victorian age reflected in the poetry.

477. **VICTORIAN PROSE.**
(3-0) Cr. 3. Alt. W. Offered 1971.
Prerequisite: 376A.
Selected Victorian prose. Aspects of the Victorian age reflected in the prose.

494. **THE TEACHING OF ENGLISH.**
(3-0) Cr. 3. W.S.
Prerequisite: Quality point average of 2.5 in 9 credits in courses above 105 selected with the approval of the department chairman.
Materials and methods of English instruction in the secondary schools, grades 7-12; specific preparation for student teaching.

499. **SPECIAL PROBLEMS.**
Cr. Var. F.W.S.SS.
Prerequisite: 9 credits in English beyond 105; junior classification, permission of department chairman.
Designed to meet the needs of (1) students who seek work in areas other than those in which courses are offered; (2) students who desire to integrate a study of literature or language with special problems in major fields.

A. Literature
B. Language (history of the language; grammar and modern usage).
C. Semantics
D. Criticism and theory of literature.
H. Honors
COURSES PRIMARILY FOR GRADUATE STUDENTS, major or minor, open to qualified undergraduates

Courses in English

503. PROBLEMS IN WRITTEN COMMUNICATION. (3-0) Cr. 3. W.S.S.II.
Prerequisite: Permission of instructor.

504. ADVANCED IMAGINATIVE WRITING. (3-0) Cr. 1 to 3 each time taken, maximum of 6. F.W.S.S.
Prerequisite: 304A or B and permission of instructor.
Individual projects.

507. SCIENTIFIC AND TECHNICAL WRITING. Cr. 1 to 3 each time taken, maximum of 6. F.W.S.S.
Prerequisite: Permission of instructor.
Development of technical language and style since 1915. Analysis and writing of scientific prose, including abstracts, manuals, proposals, and other technical papers. Individual projects on-the-job writing in industry as arranged; advanced individual research and technical writing projects.

511. INTRODUCTION TO GENERAL LINGUISTICS. (3-0) Cr. 3. W. Alt. S.S.I. Offered 1971.
Prerequisite: Permission of instructor.
Principles of general linguistics, history of the development of modern linguistic science.

Prerequisite: Permission of instructor.
Principles of historical linguistics, application to selected problems in the development of the English language.

522. THEORY OF LITERATURE. (3-0) Cr. 3. S.S.S.II.
Prerequisite: 9 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. (3-0) Cr. 3. Alt. S. Offered 1970.
Prerequisite: 9 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.S.S.I.
Prerequisite: 18 credits in literature.
Required of candidates for the master’s degree.

532. MODERN SATIRE. (3-0) Cr. 3. Alt. S. Offered 1971.
Prerequisite: 9 credits in American, British, or world literature.
Satire since World War I.

534. LITERATURE AND SCIENCE. (3-0) Cr. 3. F.
Prerequisite: 9 credits in literature including 375A; Hist. 430B or 510.
Seventeenth and eighteenth centuries. Changes wrought by scientific developments in world view, conception of imagination and theory of language as these are reflected in the literature of the period.

562. AMERICAN TRANSCENDENTALIST WRITERS. (3-0) Cr. 3. S. Alt. S.S.I. Offered 1971.
Prerequisite: 9 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. Alt. S.S.I. Offered 1970.
Prerequisite: 9 credits in American literature including 364A.
Major developments in the American novel to 1900.

564. SIGNIFICANT AMERICAN NON-FICTION. (3-0) Cr. 3. W. Alt. S.S.I. Offered 1970.
Prerequisite: 9 credits in American literature including 364A.
Significant non-fiction from the 1840’s as reflected by essayists of distinction. Emerson, Thoreau, Twain, William-James, Henry Adams, Vedder, Santayana, Bourne, Mencken, F. B. White, and others.

566. MAJOR AMERICAN POETS. (3-0) Cr. 3 each time taken, maximum of 6. W. Alt. S.S.I. Offered 1971.
Prerequisite: 9 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.

570. ENGLISH POETRY OF THE SEVENTEENTH CENTURY. (3-0) Cr. 3. Alt. W. Offered 1970.
Prerequisite: 9 credits in English literature including 375A.
English poetry from the metaphysicals to the Restoration wits, exclusive of Milton.

571. THE AUGUSTANS. (3-0) Cr. 3. Alt. F. Offered 1969.
Prerequisite: 9 credits in English literature including 375A.
Pope and his circle. Characteristics of neoclassicism. Spirit of the age and its impact on later thinking.

Prerequisite: 9 credits in English literature including 374A.
Poetry and prose of the sixteenth and early seventeenth centuries.

574. CHAUCER. (3-0) Cr. 3. F. Alt. S.S.I. Offered 1970.
Prerequisite: 9 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. S.S.I. Offered 1971.
Prerequisite: 9 credits in English literature including 375A.
Paradise Lost. Paradise Regained. Samson Agonistes. Selected minor poetry and prose, considered against the social, intellectual, and artistic background of Milton’s age.
576. ROMANTIC WRITERS.
(3-0) Cr. 3 each time taken, maximum of 6. Alt. F. Offered 1971.
Prerequisite: 9 credits in English literature including 376A.
Wordsworth, Coleridge, and selected minor contemporaries: Byron, Shelley, and Keats and selected minor contemporaries

577. VICTORIAN WRITERS.
(3-0) Cr. 3 each time taken, maximum of 6 Alt. F. Offered 1969.
Prerequisite: 9 credits in English literature including 376A.
Selected Victorian and Edwardian authors

579. BRITISH DRAMA, 1660-1700.
(3-0) Cr. 3. Alt. W. Offered 1971.
Prerequisite: 9 credits in English literature including 375A.
Restoration comedy, heroic tragedy, and their successors as seen in the plays of Dryden, Wycherley, Etherege, Otway, Congreve, and Vanbrugh

580. SHAKESPEARE.
(3-0) Cr. 3. W. Alt. SSII. Offered 1970.
Prerequisite: 9 credits in English literature including 464B.
Shakespeare as poet and dramatist; Chef critical schools and areas of scholarship

590. SEMINAR.
Cr. arr. F.W.S.SS.
Prerequisite: Permission of department chairman.
A Individual authors
B Literary periods and movements, history of ideas
C Literature, criticism
D Theory and criticism
E Language and linguistics, semantics

599. SPECIAL TOPICS.
Cr. Var. F.W.S.SS.
Prerequisite: Permission of department chairman.
A Linguistics, semantics
B Literature; criticism
C Rhetorical analysis, communication

COURSES FOR GRADUATE STUDENTS, major or minor

Courses in English
690. RESEARCH.

699. SPECIAL TOPICS.
Cr. var. F.W.S.SS.

COURSES PRIMARILY FOR UNDERGRADUATE STUDENTS

Courses in Speech and Telecommunicative Arts

15. REMEDIAL SPEECH.
(0-2) Cr. O. F.W.S.
Prerequisite: Permission of instructor.
Analysis of the student's speech handicaps followed by intensive training or therapy in the speech clinic

120. INTRODUCTION TO THEATRE.
(3-0) Cr. 3. F.W.S.
Development of the performing arts from antiquity to the present

125. FUNDAMENTALS OF ACTING.
(3-0) Cr. 3. F.W.S.
Theory and practice in acting; experience in creating characterizations

206A, 206B, 206C. TELEVISION WORKSHOP.
(0-4) Cr. 2 each. F.W.S.SSI.
Prerequisite: 206B: 206A; 206C: 206B.
206A: Functions of studio facilities, duties of television production team; practice in various duties. 206B: On-the-air experience in educational television production and direction via closed circuit or floor work and talent in WOIT TV programs. 206C: Continuation of 206B

207. VOICE AND DICTION.
(3-0) Cr. 3. F.W.S.SSI.
Principles underlying development of acceptable habits of speech; voice, enunciation, pronunciation, pause

208. PHONETICS.
(3-0) Cr. 3. F.W.S.
American speech sounds and the international phonetic alphabet, exercises in diction and phonetic transcription

211. FUNDAMENTALS OF SPEECH.
(3-0) Cr. 3. F.W.S.SSI. SSII.
Prerequisite: Engl. 105 or 132.
Fundamental principles of public speaking, audience analysis, interest and attention, selection and organization of speech material, delivery. Practice in preparation and delivery of extemporaneous speeches

228A, 228B. DEVELOPMENT OF THE MOTION PICTURE.
(2-2) Cr. 3 each. 228A: F.S.; 228B: W.
Prerequisite: Engl. 105 or 132.
228A: Early development of motion pictures, individuals responsible for major advances in theory and technique. 228B: Recent developments and social trends in motion pictures.

232A, 232B, 232C. ARGUMENTATION AND DEBATE
232A: (3-0) Cr. 3. F.
232B: (3-0) Cr. 3. W.
232C: Cr. 1-3 each time elected, maximum of 6. F.W.S.
Prerequisite: 232A and 232B: Engl. 105 or 132.
232A: Practice in preparation and presentation of argumentative speeches, emphasis on ethical responsibilities of the advocate, analysis, reasoning, and refutation. Emphasis on debate research, case, and judging, practice in various debate forms. 232C: Participation in intercollegiate debate, field trips

301. SURVEY OF RADIO AND TELEVISION 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.

302. 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.

305. GENERAL SEMANTICS.
(3-0) Cr. 3. F.W.S.S.SI.
Prerequisite: Engl. 105 or 132.
Nature of symbolic processes; influence of verbal habits in determining 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.

312A, 312B. BUSINESS AND PROFESSIONAL SPEAKING.
(3-0) Cr. 3 each. 312A: F.W.S.; 312B: F.W.S.
Prerequisite: 211.
312A: Fundamental principles in oral communication for common types of professional speeches; emphasis of style and quality of work. 312B: Speech for teachers; oral communication in the teaching profession; training in classroom-oriented communication activities; extensive use of video recorder for analysis of presentation.

319. MOTION PICTURE TECHNIQUES.
(T. Jl. 319.) See Technical Journalism.

320. DRAMATICS.
Cr. 1 to 3 each time elected, with a maximum of 6 credits. F.W.S.
Prerequisite: Engl. 105 or 132, permission of instructor.
Rehearsal and production of plays.

321. RADIO WORKSHOP.
Cr. 1 to 3 each time elected, with a 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.

324A, 324B, 324C. DRAMATIC PRODUCTION.
(3-0) Cr. 3 each. 324A: F.W.S.; 324B: W.; 324C: S.
Prerequisite: Engl. 105 or 132.
324A: Principles of play production, choosing the play, casting, rehearsing, staging, and lighting. 324B: Costuming and make-up, techniques of make-up for television and theatre, use of color and materials. 324C: Theory of directing plays with special attention given to problems of casting, rehearsal, blocking, movement, picturization, style, mood, and character business.

325. TECHNICAL THEATRE.
(3-0) Cr. 3. F.W.S.
Prerequisite: Engl. 105 or 132.
Principles and history of scene design and staging methods.

326. TELEVISION PERFORMANCE.
(1-4) Cr. 3. W.S.
Prerequisite: 207 or equivalent.
Problems of the television performer, adaptations in composition and interpretation which the medium requires of the announcer, narrator, master of ceremonies, or actor. Studio situations designed to aid student in improving his performance skills.

328A, 328B. TELEVISION PRODUCTION AND DIRECTION.
(3-0 and 1-4) Cr. 3 each. 328A: F; 328B: W.
Prerequisite: 328A: Two quarters of 206, 326; 328B: 328A.

334A, 334B. PERSUASION.
(3-0) Cr. 3 each. 334A: F.W.S.; 334B: S.
Prerequisite: 334A: 211; 334B: 334A.
334A: Principles and methods of persuasive speaking; discovery and use of evidence; proof, refutation; appeals; organization. Practice in preparation and delivery of persuasive speeches upon topics of current interest. 334B: An examination of research in persuasion and of scientific methods of evaluating oral persuasion; analysis of the significance of oral persuasion as a means of influencing society.

336A, 336B. GROUP DISCUSSION.
(3-0) Cr. 3. F.W.S.
Prerequisite: 211.
Analysis of the relations between speakers, speeches and political or historical events.

348. INFORMATIVE WRITING FOR RADIO AND TELEVISION.
(T. Jl. 348) See Technical Journalism.

361. HISTORY OF THEATRE.
(3-0) Cr. 3. F.
Prerequisite: 120.
Survey of the development of the theatre and theatrical art to the twentieth century.

362. CREATIVE DRAMATICS.
(3-0) Cr. 3. W.S.
Prerequisite: Junior classification, and permission of instructor.
Improvization and playmaking with children and adults in the school, home, and community; emphasis on the elementary and pre-school child.

363. PLAY SELECTION.
(3-0) Cr. 3. S.
Prerequisite: Junior classification and permission of instructor.
Study of plays suitable for production by school and community groups.

375. SPEECH CORRECTION PRINCIPLES.
(3-0) Cr. 3. F.W.S.SSI.
Prerequisite: 211.
Speech disorders found among school children; methods which the classroom teacher can employ in handling these disorders, referral and cooperation with the speech therapist.

376A, 376B. SPEECH DISORDERS.
(3-0) Cr. 3 each. 376A: F.S.; 376B: W.
Prerequisite: 375B.
376A: Articulation disorders; study of speech development in children, nature, causes and management of articulation and voice disorders. 376B: Stuttering: study of theories and research on stuttering behavior and methods of management.
400A, 400B, 400C. TELECOMMUNICATIVE ARTS. (T.JI. 400C) (1-3 to 9) Cr. 1 to 3 each time elected. 400A: Maximum of 9 credits; 400B: Maximum of 10 credits; 400C: Maximum of 8 credits. 400A, 400C: F.W.S.; 400B: F.W.S.SSI. Prerequisite: 400A: 302, 301 or T.JI. 475, permission of instructor. 400B: 206, 302, 326, 328A, 328B, permission of instructor. 400C: 400B, T.JI. 476, permission of instructor. 400A: Creating, writing, and directing of a variety of educational and public information programs. Research methods; narrative and expository writing techniques; audio control; direction of talent; production procedures. Selected programs each week on WOI-FM-AM. 400B: Television. Students who previously have emphasized writing, lighting, staging, newscasting, demonstration, and performing will work as crews to create, write, direct, and produce programs for weekly broadcasts on WOI-TV. 400C: The first of a four quarter sequence starts in the spring, and is offered as a lecture and discussion course in production procedures. Advanced students write, direct, and produce dramatic and informational sound motion pictures during the following three quarters.

495. THE TEACHING OF SPEECH. (3-0) Cr. 3. W. Prerequisite: Quality point average of 2.5 in 9 credits of speech in courses selected by students with approval of department chairman. Problems, methods, and materials related to the teaching of speech in the secondary school. Particular attention to the extracurricular program.

499. SPECIAL PROBLEMS. Cr. 2-5 each time taken. F.W.S.SSI. Prerequisite: 12 credits in speech, junior classification, permission of department chairman. A. Public Address. B. Speech Correction C. Rhetoric. D. Speech Education. E Radio, Television and Film H. Honors

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.; Dorothy Lee, Ph.D.; Margaret I. Liston, Ph.D.; Louise J. Peet, Ph.D.; Mary S. Pickett, Ph.D.

Associate Professors: Neva M. Petersen, M.S.; Elmer Schwieder, Ph.D.; Naomi D. Shank, B.S.; Helen Wells, Ph.D.; Esther Whetstone, M.S.

Assistant Professors: Anne R. Coveney, Ph.D.; Alice Petersen, Ph.D.; David Weltha, Ph.D.

Undergraduate Study

For undergraduate curriculum in family environment leading to the degree Bachelor of Science, see Home Economics, Curricula.

The Department of Family Environment offers courses designed to develop an understanding of the family as an environment and in environment. Several of the courses are interdisciplinary in nature and are taught by teams of staff members from several disciplines. Basic concepts and principles from the social, physical, and biological sciences are applied through the study of consumer economics, management, family relations, household equipment and housing. The program is designed to provide a broad based education which will prepare the student for many career opportunities in addition to a more satisfying life as a family and community member.

The curriculum in family environment prepares the student for a wide variety of positions in industry, education, government, and family and social “helping” services. Examples would include finance and credit organizations, home economics extension, social welfare and family service agencies, urban housing, consumer information departments in utilities, and testing and development laboratories in industry and business.

Special programs in consumer economics or family environment and related science may be worked out for qualified students. See department head for details.

Graduate Study

The department offers major work for the degree Master of Science and minor work for students taking major work in other departments. Work may be taken for the degree Doctor of Philosophy as a divided 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. Training in the biological, chemical, physical or social sciences may be suitable background depending on the student’s objectives.

Graduate students may make up deficiencies during the first year of graduate study without receiving graduate credit for such courses.

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, 485, 488, 489.

COURSES PRIMARILY FOR UNDERGRADUATE STUDENTS

185. ORIENTATION TO FAMILY ENVIRONMENT. (3-0) Cr. 3. F.W.S.
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. SSI.
Prerequisite: High school physics or chemistry. Selection, use and care of materials and equipment. Application of basic principles in the utilization of water, electricity, gas, light and heat for doing the work and maintaining health and comfort in the home

270. THE INDIVIDUAL AND HIS FAMILY. (4-0) Cr. 4. F.W.S.SSI.SSI.
Prerequisite: Psych. 101, Soc. 134. Interrelations of the individual and his family through the stages of the family's life cycle.

308. MODERN LIGHTING FOR RESIDENTIAL INTERIORS. (2-4) Cr. 3. F.W.S.
Prerequisite: Sophomore classification. 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.SSI.
Prerequisite: Sophomore classification. Electric and non-electric appliances for food preparation, dishwashing, food waste disposal, care and maintenance of the home, construction and care of clothing, 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.

375. MANAGEMENT IN THE FAMILY. (4-0) Cr. 4. F.W.S.S flirt.
Prerequisites: 270, Econ. 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. W.
Prerequisite: 270.
Standards and levels of living and life styles. Relationship of environmental conditions to family life patterns.

404. MEASUREMENT METHODS IN HOME EQUIPMENT. (3-3) Cr. 4. F.
Prerequisites: 254, Phys. 106.
Experimental and non-experimental research methods applied to problems related to equipment used in the home. Control and measurement of gas, electricity, heat, light and sound.

408. EQUIPMENT FOR CARE OF MODERN FABRICS. (2-6) Cr. 4. S.
Prerequisite: Junior classification.

410. FOOD RELATED MAJOR HOME APPLIANCES. (3-3) Cr. 4. W.
Prerequisites: 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. (Econ. 415) (3-0) Cr. 3. F.W.
Prerequisites: Econ. 242, Psych. 101, Soc. 134.
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.

421. DEMONSTRATION TECHNIQUES. (2-4) Cr. 3. W.S.
Prerequisites: 254, Sp. 211, Senior classification.

Demonstration as a means of integrating and communicating knowledge. Planning and presenting direct audience demonstrations for groups of varying size, background and interest. Reservation required.

425. SEMINAR. (1-0) Cr. 1. F.W.S.
Prerequisite: Junior classification.

445. RESIDENTIAL UTILITIES. (2-3) Cr. 3. S.
Prerequisites: 240, 254.
Relation of comfort, health, safety to the following: electric wiring, plumbing, heating, cooling, communications systems used in the home. Consumer responsibility for solution of air and water pollution problems.

446. HOUSE EVALUATION. (2-3) Cr. 3. F.
Prerequisite: 445 or permission of instructor. Important points in selection of a dwelling, considering safety, comfort, convenience and ease of maintenance.

470. COMMUNICATION WITH FAMILIES. (3-0) Cr. 3. S.
Prerequisites: 270, 385.
Principles of communicating with families of different socio-economic levels. Exploration of the role of empathy and sensitivity in establishing helping relationships with families.

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. (Econ. 488) (3-0) Cr. 3. F.W.S.S.
Prerequisites: Econ. 242, Psych. 101, Soc. 134.
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.
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. F.W.S.S.SII. S.
Prerequisite: 12 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.
H Honors Program.

COURSES PRIMARILY FOR GRADUATE STUDENTS, major or minor, open to qualified undergraduates:

500. FAMILY ENVIRONMENT SHORT COURSES. Cr. arr. S.S.SII.
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.
G General Family Environment.
504. RESEARCH METHODS AND TECHNIQUES I. 
(2-0) Cr. 2. F.
Prerequisite: Graduate classification.
Survey of research methods and techniques applicable to family environment research. Emphasis on interpretation of studies using different techniques. Selection of techniques for varied research problems.

505. RESEARCH METHODS AND TECHNIQUES II. 
(2-3) Cr. 3. W.
Prerequisite: 504.
A For students in the physical areas of family environment: research methods and techniques, instrumentation, data analysis.
B For students in the socio-economic areas of family environment: research methods and techniques, survey procedures, questionnaire development, data analysis.

519. CONSUMER DYNAMICS. 
(3-0) Cr. 3. S.
Prerequisites: 415, 488.
Consumer responsibilities in a dynamic society. Appraisal of interactions with public and private institutions serving consumer interests.

520. FOOD ECONOMICS. 
(Econ. 520) (3-0) Cr. 3. S.
Prerequisites: 9 credits in economics, Psych. 101, Soc. 134.
Analysis of factors related to trends in world population growth and food consumption. Economic, psycho-social and managerial aspects of food in family life. Evaluation of public policies and programs with respect to food consumption.

521. SOCIAL AND ECONOMIC ASPECTS OF HOUSING. 
(3-0) Cr. 3. W SS.
Prerequisites: Econ. 242, Psych. 101, Soc. 134.
Selected managerial, legal, economic and public policy aspects of family housing.

522. TIME AND HUMAN RESOURCES. 
(3-0) Cr. 3. F.
Prerequisite: 375 or permission of instructor.
Time and space as basic resources in family life. Social and technical concepts for furthering attainment of family goals through work and leisure.

COURSES FOR GRADUATE STUDENTS, major or minor

604. SEMINAR. 
Cr. 1-3. F.W.S.
A Family Relations and Human Development
B Housing
C Consumer Economics and Management
D Household Equipment
G General Family Environment

690. RESEARCH. 
Cr. arranged. F.W.S.SSI.SSII.
A Family Relations and Human Development
B Housing
C Consumer Economics and Management
D Household Equipment
G General Family Environment

FARM OPERATION
For information about this curriculum, see College of Agriculture, Curricula.

FISHING AND WILDLIFE BIOLOGY
For description of courses, see Zoology and Entomology.
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.

Four majors are offered: 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, 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 business and food research

Graduate Study

The department offers major work for the degrees Master of Science and Doctor of Philosophy in food science and in nutrition and minor work for students taking major work 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, bac-
teriology, food technology, psychology, physiology, economics, statistics or journalism. 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. F.W.S.S.S.
Prerequisite: Zool. 106 or 155.
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. F.W.
Prerequisite: Freshman or sophomore classification.
Scope and significance of food and nutrition, professional opportunities

208. PRINCIPLES OF FOOD PREPARATION. (3-6) Cr. 5. F.W.
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

Prerequisite: 107, Chem. 231.
Nutritional needs during reproduction, growth and later life; adjusting meals to meet the needs of family members. Not available to students with credit in 305 or 410.

303. FAMILY MEAL MANAGEMENT. (3-3) Cr. 4. F.W.S.
Prerequisite: 107 or 305, and 208 or 215.
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.S.S.
Prerequisite: B. & B. 301 or 304 or 404; Zool. 155 or 355.
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. 106 or 111, Soc. 218. Advance reservation required.
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. Majors only.
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.S.
Prerequisite: 215 and B. & B. 301 or 304.
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 populations 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.
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, H.Ed. 415.
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.
(1-3) Cr. 2. F.
Prerequisite: 320, 9 credits in social sciences. 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.
Prerequisite: 215, 320, B. & B. 301 and 311, F.E. 254.
Experimental approach to the study of factors influencing behavior of foods: eggs, emulsions, gels, batters and doughs.

422. PRINCIPLES OF FOOD SCIENCE II.
(2-6) Cr. 4. W.

COURSES PRIMARILY FOR GRADUATE STUDENTS, major or minor, open to qualified undergraduates

500. SHORT COURSE.
Cr. arr. SSIS.SSI.
Prerequisite: Permission of instructor.

521. 522, 523. SELECTED STUDIES IN FOOD SCIENCE.
(1-6) Cr. 3 each. Yr.
Prerequisite: 215, B. & B. 301 or 311, Bact. 304.
521, 522 Experimental approach to the study of chemical and physical properties of inter-active 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. S.
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. F.W.S.SSI.SSI.
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. S.
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.

608. MICROBIOLOGICAL ASSAYS IN FOOD AND NUTRITION.
(1-6) Cr. 3. S.
Prerequisite: 606. Roderuck.
Application of the micro-biological assay to the quantitative estimation of vitamins and amino acids in foods, tissues and metabolic materials.

609. SEMINAR.
Cr. R.F.W.S.
Required of all graduate majors in the Food and Nutrition Department.

614. RESEARCH.
F.W.S.SSI.SSI.
B Food Science Carlin, Miller.

615. ADVANCED NUTRITION.
(3-0) Cr. 3. F.W.
Prerequisite: 601, Arnrich, Brewer, Kenney, Roderuck.
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 non-sequential courses on such topics as protein, fat, carbohydrate.

680. MODERN VIEWS OF NUTRITION.
FOREIGN LANGUAGES

Alfred P. Kehlenbeck, 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 Professor: Terezie Michelsons, M.A.

Assistant Professors: Robert Bernard, Ph.D.; Charlotte Bruner, M.A.; Arturo Graupera, Dr. en Der.; Harry A. Kahn, M.A.; Judith Noble, Ph.D.; Floyd Pace, M.S.; Fred Pohorille, M.A.; Clyde Thogmartin, M.A.


Undergraduate Study

The instruction offered in the Department of Foreign Languages is designed to give students the fundamentals of the languages offered and to introduce them to the culture of the people whose language is being studied.

The department offers majors in French, German, Russian, and Spanish. For a complete statement of degree requirements see Curriculum, Sciences and Humanities.

Opportunities for teaching foreign languages in public schools are excellent. A student who wishes to qualify for a teacher's certificate in foreign languages must take a minimum of 45 credits in one language for full-time certification. For certification in foreign languages, half time or less, 30 credits in one language will be required. In order to be permitted to do student teaching (DSt. 417G) the student must have completed a composition and conversation course, either elementary or advanced, in the language concerned. For the University statement of requirements for teacher certification, see College of Education.

Students majoring in foreign languages may substitute a second major in international relations for the two minors required in the College of Sciences and Humanities. See International Relations.

Students entering the University with two or more years' instruction at the high school level in a language taught by this department may satisfy the college's requirement in languages in one of the following ways: (1) by satisfactory completion of a special examination, for which the grade of P and appropriate credits toward graduation will be awarded; (2) by attendance as an auditor in the regular basic sequence in the same language and completion of a special examination, for which the grade of P and appropriate credit toward graduation will be awarded; (3) by satisfactory completion of the basic sequence in another language; (4) by satisfactory completion of a second-year or higher level course in the same language. Under no circumstances will a student be given credit with the usual letter grade (A-F) for a basic language sequence in which he has received two or more years of instruction at the high school level. Students from foreign countries will not be permitted to enroll in courses below the 300-level in their native languages.

COURSES PRIMARILY FOR UNDERGRADUATE STUDENTS

Courses in French

101, 102, 103. ELEMENTARY FRENCH.
(3-2) Cr. 4 each. 101: F.W.; 102: W.S.; 103: S. Prerequisite: 101: Elementary sequence open only to students with no previous instruction in French; 102: 101; 103: 102.

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.F.W.S.

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, 205, 206. FRENCH PRONUNCIATION.
(2-0) Cr. 2 each. Yr.

Prerequisite: 103 or equivalent. Required of French majors. Open to majors in other languages or, with special permission of the department, to non-majors who desire to develop a speaking facility. Taken concurrently with 211, 212, 213.

Diction and intonation. Development of proper French accent through phonetics, mechanics of sound formation, syllabification, inflection and intonation
Courses in German

131, 132, 133. ELEMENTARY GERMAN.
(3-2) Cr. 4 each. 131: F.W.: 132: W.S.: 133: S.
Prerequisite: 131: Elementary sequence open only to students with no previous instruction in German. 132: 131: 133: 132.
Introduction to German through the aural-oral approach with intensive use of the language laboratory.

131A, 132A, 133A. READING KNOWLEDGE OF SCIENTIFIC GERMAN.
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. F.W.
Prerequisite: 234: 133 or 133A or equivalent; 235: 234 or equivalent.
Review of grammar necessary for reading scientific literature. Extensive reading from the physical, biological, and social sciences.

Courses in French

207, 208, 209. SURVEY OF FRENCH LITERATURE.
(3-0) Cr. 3 each. Yr.
Prerequisite: 103 or equivalent.
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 Century and Early 19th Century. 209: Late 19th and 20th Century.

211, 212, 213. INTERMEDIATE FRENCH.
(2-2) Cr. 3 each. Yr.
Prerequisite: 211: 103 or equivalent; 212: 211 or equivalent; 213: 212 or equivalent. Required of French majors open to majors in other languages and, with special permission of the department, to non-majors who desire to develop a speaking facility.
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 or equivalent.
Development of writing and speaking facility using simple composition exercises and selected reading texts as a basis for conversation practice and vocabulary building.

314, 315, 316. FRENCH CIVILIZATION.
(3-0) Cr. 3 each. Yr.
Prerequisite: 213 or equivalent. Required of majors.
Study of history, art, architecture, music, social institutions of France. Lectures and discussions in French. 314: Origins of the French nation through the Visigothic 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 or equivalent.
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 or equivalent.
Specially designed for majors. Requires ability to understand the spoken word as well as a reading knowledge. Lectures and discussions in French. French prose from its beginnings to the present day with special emphasis on the development of the novel form. 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 or equivalent.
Specially designed for majors. Requires ability to understand the spoken word, as well as a reading knowledge. Lectures and discussions in French. French dramatic literature from the Middle Ages to the present day. 410: Middle Ages and Renaissance theater. The beginnings of the classical drama. 411: Classical drama. Racine and Molière. 412: The theater of the 18th Century. Realism, Romanticism, and Naturalism in the theater. 413 The theater since 1900.

413, 414, 415. FRENCH POETRY.
(3-0) Cr. 3 each. Yr.
Prerequisite: 313 or equivalent.
Specially designed for majors. Requires ability to understand the spoken word, as well as a reading knowledge. Lectures and discussions in French. French poetry from the Middle Ages to the present day. 413: Epic, didactic, and lyric poetry of the Middle Ages. 414: Renaissance poetry, poetry of the Classic Age. 415: 18th Century poetry, poetry of the Romantic and Realistic movements. Parnassians and Symbolists. 416 The Moderns. Mallarmé, Verhaeren, Valery, Aragon, Prevert, and others.

236, 237, 238. INTERMEDIATE GERMAN.
(3-0) Cr. 3 each. Yr.
Prerequisite: 236: 133 or 133A or equivalent; 237: 236; 238: 237.

239, 240, 241. GERMAN CIVILIZATION.
(3-0) Cr. 3 each. Yr.
Prerequisite: 133 or 133A or equivalent.
Readings from a cultural history of Germany for gaining practice in reading and accumulating factual data on German civilization.

339, 340, 341. ELEMENTARY GERMAN COMPOSITION AND CONVERSATION.
(3-0) Cr. 3 each. Yr.
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 or equivalent; 225: 224 or equivalent; 226: 225 or equivalent.

Courses in Spanish

151, 152, 153. ELEMENTARY SPANISH.
(3-2) Cr. 4 each. 151. F.W.; 152. W.S.; 153. S.
Prerequisite: 151: Elementary sequence open only to students with no previous instruction in Spanish. 152: 151; 153: 152.
Use of 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 or equivalent; 252: 251 or equivalent; 253: 252 or equivalent.
Review of the basic elements of the Spanish language. Further intensive practice in oral communication.

254, 255, 256. SPANISH CIVILIZATION.
(3-0) Cr. 3 each. Yr.
Prerequisite: 153 or equivalent.
From earliest times to the present. Survey of the art and architecture as well as the social structure of Spanish life. The spring quarter is devoted exclusively to the study of Latin America.

351, 352, 353. INTRODUCTION TO SPANISH LITERATURE.
(3-0) Cr. 3 each. Yr.
Prerequisite: 253 or equivalent.
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.

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.

451, 452, 453. HISPANIC POETRY.
(3-0) Cr. 3 each. Yr.
Prerequisite: 353 or equivalent.
Hispanic poetry from the modern era. Poetry of Spanish America.

464, 465, 466. INTRODUCTION TO SPANISH AMERICAN LITERATURE.
(3-0) Cr. 3 each. Yr.
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.

467, 468, 469. ADVANCED SPANISH COMPOSITION AND CONVERSATION.
(3-0) Cr. 3 each. Yr.
Prerequisite: 356 or equivalent.
Intensive use of the language laboratory for practice in dictation, intonation and oral interpretation of literary material. Writing of themes in Spanish on selected subjects of cultural value.

473, 474, 475. THE HISPANIC NOVEL.
(3-0) Cr. 3 each. Yr.
Prerequisite: 353 or equivalent.
Hispanic prose fiction from medieval times to present. Development of forms of fiction in Spanish America.

477, 478, 479. HISPANIC DRAMA.
(3-0) Cr. 3 each. Yr.
Prerequisite: 356 or equivalent.
The drama of Spain from the medieval period to the modern era. The drama of Spanish America.
Special Courses

476. METHODS OF TEACHING FOREIGN LANGUAGES.
Cr. 3. W.
Prerequisite: 18 credits in foreign languages

Prerequisite: Permission of department head. Designed to meet the needs of (1) students who seek work in areas other than those in which courses are offered, (2) students who desire to integrate a study of literature or language with special problems in major fields.

499. SPECIAL PROBLEMS.
Cr. 1-9 each time elected. F.W.S.

FORESTRY

Henry H. Webster, Ph.D., Head of Department

Professors: Dwight W. Bensend, Ph.D.; Leonard F. Kellogg, M.F., (Emeritus); Harold S. McNabb, Jr., Ph.D.; Wayne H. Scholles, Ph.D.; George W. Thomson, Ph.D.; Kenneth D. Ware, Ph.D.

Associate Professors: Raymond F. Finn, Ph.D.; Frederick S. Hopkins, Jr., Ph.D.; Julius A. Larsen, Ph.D.; Dean R. Prestemon, Ph.D.

Assistant Professors: J. D. Wellons, III, Ph.D.; John C. Meadows, Ph.D.

Instructor: Victor G. Smith, M.Sc.F.

Undergraduate Study

For undergraduate curriculum in forestry leading to the degree Bachelor of Science, see Forestry Curriculum.

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. Many private firms as well as various federal, state, and local agencies seek graduates of the forest management option 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 option. With appropriate graduate study, the range of opportunities is expanded to include research and education as well as more specialized administrative positions.

An eight-week summer camp between the freshman and sophomore year is required of all students.

Graduate Study

The department offers programs leading to the degrees Master of Forestry, Master of Science in forest economics, forest management, forest mensuration, forest biology, and wood technology, and the degree Doctor of Philosophy 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.

The foreign language requirement for the degree Master of Science may be waived upon recommendation of the department head.

COURSES PRIMARILY FOR UNDERGRADUATE STUDENTS

101. INTRODUCTION TO FORESTRY. (3-0 or 3) Cr. 3 or 4. F.
Evaluation of trends in demand for various products and services of forests, implications for current and future management of public and private forest resources, production possibilities, problems, policy issues. Students who have attended Forestry Summer Camp take this course for three credits without the laboratory.

110. SEMINAR. (1-0) Cr. R.F.
Discussion of current topics relating to forestry.

160. RECREATIONAL USE OF FOREST RESOURCES. (3-0) Cr. 3. W.
Trends in outdoor recreation, role of public agencies and private firms in providing opportunities for outdoor recreation, use of resources for recreational purposes, Development of policies; current problems and conflicts, prospects.

201. FOREST BIOLOGY. (0-9) Cr. 3. Summer Camp.
Field study of the relationships of physical factors to the productivity of forests in a major forest area, forestry practices to increase the sustainable production of timber, water, and forage values.

202. WOOD UTILIZATION. (0-9) Cr. 3. 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 MENSURATION AND MAPPING. (0-12) Cr. 4. Summer Camp.
Field study and practice in the measurement of logs, trees, and forest stands. Field surveying, collecting data and preparing forest maps.

204. FOREST 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. (3-3) Cr. 4. S.
Prerequisite: 203, Math. 110. The measurement of trees, logs, and forest products. Principles of estimation by sampling and applications to the inventory of forest resources.

357. FOREST SOILS. (Agron. 357) See Agronomy.

376. APPLIED ENTOMOLOGY. (Zool. 376) See Zoology and Entomology.

380. WOOD TECHNOLOGY I. (2-6) Cr. 4. F.
Prerequisite: Bot. 101. Anatomy, macroscopic identification and introduction to chemical and physical properties of wood.

381. WOOD TECHNOLOGY II. (3-0) Cr. 3. W.
Prerequisite: 380. Relation of wood properties to manufacturing processes and uses. Grading, and marketing of major wood products.

386. SEASONING AND PRESERVATION OF WOOD. (2-3) Cr. 3. S.
Prerequisite: 389. Seasoning: protection of wood from insects and decay; fire retardant treatment.

389. WOOD-LIQUID RELATIONS AND SPECIFIC GRAVITY. (2-3) Cr. 3. F.
Prerequisite: 380, Chem 231 or equivalent. Cell wall structure, wood in relation to moisture, specific gravity.

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, pre-suppression and suppression. Fire control equipment.

400. FOREST CONSERVATION. (3-0 or 3) Cr. 3 or 4. F.
Prerequisite: Bot. 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.

440. SPECIAL PROBLEMS. Cr. 1 to 6 each time elected. F.W.S.
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

442. DYNAMICS OF FOREST STANDS. (2-3) Cr. 3. W.
Prerequisite: 241 and credit or classification in 497. Measurement of growth of trees and stands. Quantification of stand structure and dynamics. Prediction of future growth and structure.

444. FOREST RESOURCE SURVEYS. (4-0) Cr. 4. Alt. S. Offered 1971.
Prerequisite: 241 or Stat. 201. Survey of objectives, problems and methods of quantification and inventory of various forest resources and uses. Survey of irrigation and drainage, water and recreational resources. Methods, factors, variables and sampling methods for providing estimates necessary to manage these resources within the institutional context of forestry.
445. **FOREST PHOTOGRAMMETRY AND PHOTO-INTERPRETATION.**  
(2-6) Cr. 4. S.  
Prerequisite: 241, C.E. 210.  
Use of aerial photographs in forest management. Measurement of land, trees and timber stands on vertical photographs. Preparation of type, planimetric, and topographic maps from aerial photographs. Forestry students only.

447. **GENERAL PHOTOGRAMMETRY AND PHOTO-INTERPRETATION.**  
(2-2) Cr. 3. W.  
Use of aerial and terrestrial photographs in resource management and research. Techniques of measurement, cartographic methods and interpretation applicable to controlled photographs.

460. **FOREST RECREATION.**  
(3-0) Cr. 3. W.  
Prerequisite: 470 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.

470. **FOREST ECONOMICS.**  
(Econ. 470) (4-2) Cr. 5. F.  
Prerequisite: 241, Econ. 242.  
Economic factors and analysis underlying management decisions by the forestry firm. Institutional factors. Marketing of forest goods and services. Appraisal.

474. **FOREST OPERATIONS ANALYSIS.**  
(2-3) Cr. 3. F.  
Prerequisite: 470, 474, Math. 110.  
Application of mathematical and statistical models to the solution of managerial problems in forestry. Design and collection of information. Design of harvesting and processing systems for cost and quality control. Applications to other forestry operations.

476. **POLITICAL ECONOMY OF FORESTRY.**  
(4-3) Cr. 5. S.  
Prerequisite: 370.  
Historical analysis of economic, institutional and technological forces affecting the forest economy. Survey of contemporary policy issues with focus on manipulation of social variables. Social planning for forest resources in the United States and developing nations.

481. **CHEMICAL PROCESSING OF WOOD.**  
(3-3) Cr. 4. Alt. W. Offered 1970.  
Prerequisite: 380, 389 recommended.  
Chemical processing of cellulose-derived products. Carbonization, destructive distillation, hydrolysis, dimensional stabilization, wood-plastic combinations.

484. **PROPERTIES OF WOOD.**  
(3-9) Cr. 3. Alt. SS. Offered 1970.  
Prerequisite: I.Ed. 205.  

487. **MECHANICAL PROCESSING AND WOOD FINISHING.**  
(3-3) Cr. 4. S.  
Prerequisite: 380.  
Mechanical processing, sawing, planing, sanding, chopping, and delignification. Veneer, plywood, and composite boards. Interior and exterior finishing of wood. Applications and serviceability of wood in building construction.

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.

497. **FOREST MANAGEMENT.**  
(5-0) Cr. 5. W.  
Prerequisite: Senior classification in forestry. Principles of organizing, regulating, and administering forest lands in conjunction with commercial harvest and multiple-use goals for both private and public ownership.

**COURSES PRIMARILY FOR GRADUATE STUDENTS, major or minor, open to qualified undergraduates**

504. **APPLIED FOREST BIOLOGY.**  
(3-0) Cr. 3. Alt. S. Offered 1971. McBride.  
Prerequisite: 302.  
Detailed analysis of the practice of silviculture in relation to silvicultural principles.

540. **SPECIAL TOPICS.**  
Cr. 2 to 5 each term elected. F.W.S.  
Prerequisite: 15 credits of acceptable graduate work, permission of instructor.  
A. Silviculture Finn, McBride.  
B. Wood Science Bensend, Prestemon, Wellons.  
C. Forest Management Thomson.  
D. Forest Economics Hopkins.  
E. Range Management.  
F. Forest Mensuration and Photogrammetry Thomson, Ware.

543. **FOREST MENSURATION.**  
(3-0) Cr. 3. W.  
Prerequisite: 442. Ware.  
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. F.  
Prerequisite: 470, Econ. 308. Hopkins.  
Economic analysis of production alternatives in forestry firms. Critical analysis of related research.

580. **CHEMISTRY OF WOOD.**  
(3-0) Cr. 3. Alt. W. Offered 1971.  
Prerequisite: 481, Chem. 334. Wellons.  
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 1970.  
Prerequisite: 488, Math. 213. Wellons.  
Viscoelastic behavior of wood, time dependency of response to static, quasi-static, and dynamic stimuli. Non-destructive methods of evaluating mechanical properties of wood products.
587. ADVANCED TOPICS IN WOOD SCIENCE.  
(3-0) Cr. 3. S.  
Prerequisite: 381. Prestemon.  
Recent contributions of research and technology to product development. Areas of emphasis in basic and applied research.

594. ADVANCED FOREST MANAGEMENT.  
(3-0) Cr. 3. F.  
Prerequisite: 497. Thomson.  
A seminar approach to the critical analysis of forest management problems as exemplified in public and private forestry.

COURSES FOR GRADUATE STUDENTS, major or minor

600. RESEARCH.  
Cr. 1-11, F.W.S.S.I.I.  
A. Silviculture, Finn, McBride.  
B. Wood Science, Bensend, Prestemon, Wellons.  
C. Forest Economics, Hopkins.  
D. Forest Management, Thomson.  
E. Range Management.  
F. Forest Mensuration and Photogrammetry, Thomson, Ware.  

601. RESEARCH METHODS IN FORESTRY.  
(2-2) Cr. 3. W. Webster.  
Scientific method, hypothesis formulation and testing, project and study planning; preparation and critical analysis of study plans. Communication of research results. Institutional factors in research.

602. ADVANCED FOREST BIOLOGY.  
(3-0) Cr. 3. Alt. W. Offered 1970.  
Prerequisite: 302. McBride.  
Detailed analysis of tree processes underlying forest tree production in relation to genetic and environmental factors.

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 Professor: Wilmer J. Miller, Ph.D.

Assistant Professors: Alan G. Atherly, Ph.D.; Edward Pollak, Ph.D.

Instructor: John E. Masterson, 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 in human populations. The courses also are intended to demonstrate the broad cultural and philosophical aspects of this biological science.

Graduate Study

The department offers major work for the degrees Master of Science and Doctor of Philosophy in genetics and minor work to students taking major work in other departments.

Prerequisite to major work is the completion of a thorough undergraduate curriculum in agriculture, or in a biological science, or in a physical science with evidence of excellent scholarship and aptitude for scientific research.

Students taking major work in genetics ordinarily will 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.
COURSES PRIMARILY FOR UNDERGRADUATE STUDENTS

301. INTRODUCTORY GENETICS.
(3-0) Cr. 3. F.W.S.SSI.
Prerequisite: Elementary course in biology.
Elementary principles of genetics and their operation and significance in plant, animal, and human populations.

305. ELEMENTARY GENETICS LABORATORY.
(0-9) Cr. 3. F.W.S.
Prerequisite: Should accompany or follow 301 or 400.
Laboratory experiments illustrating the laws of heredity and their physical basis.

400. HUMAN HEREDITY.
(3-0) Cr. 3. S.

Principles of heredity in man, the relation of inheritance to disease, blood types, and eugenics.

401. INTERMEDIATE GENETICS.
(3-0) Cr. 3. F.
Prerequisite: 301 or 400.
Fundamental methods and concepts in genetics: chromosome mapping, gene structure, elementary mathematical genetics, polyploidy, and meiotic analysis.

450. SPECIAL PROBLEMS.
Cr. arr. F.W.S.SSI. SSII.
Prerequisite: 303. 401.

*Both courses cannot be used for graduation credit.

COURSES PRIMARILY FOR GRADUATE STUDENTS, major or minor, open to qualified undergraduates

500. INTRODUCTION TO MATHEMATICAL GENETICS.
(3-0) Cr. 3. S.
Prerequisite: 401, Math. 101 or equivalent.
Pollak.
Elementary probability and its application to Mendelian, population, and quantitative genetics.

536, 537. GENETIC STATISTICS.
(Stat. 536, 537) See Statistics.

540. SPECIAL TOPICS.
(0-3 to 9) Cr. Arr. F.W.S.SSI. SSII.
Prerequisite: 305, 401. Atherly, Hollander, Miller, Peterson, Robertson, Sadanaga, Welshons.

COURSES FOR GRADUATE STUDENTS, major or minor

605. CYTOGENETICS.
(3-0) Cr. 3. W.
Prerequisites: Bot. 504 or Zool. 528, Gen. 401 Robertson.
Studies of cytology and genetics in plants and animals with emphasis on crossing over and changes in chromosome structure and number.

610. PRINCIPLES OF GENETIC ANALYSIS.
(3-0) Cr. 3. F.
Prerequisite: 401.
Methods of genetic investigation, with emphasis on mutation, gene action, chromosome organization and the properties of the genetic material.

620. BIOCHEMICAL GENETICS.
(Bact. 620) (3-0) Cr. 3. S.
Prerequisite: 401.
Structure, mutation, and recombination of genes considered at the molecular level, biosynthetic pathways and gene interaction, the genetic code, protein synthesis, and regulatory mechanisms.

621. BACTERIAL GENETICS.
(Bact. 621) See Bacteriology.

630. ADVANCED PLANT GENETICS.
(3-0) Cr. 3. S.
Prerequisite: 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.
(3-6) Cr. 5. W.
Prerequisite: 305, 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 1970.
Prerequisite: 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.
(3-0) Cr. 3. Alt. F. Offered 1969.
Prerequisite: 401. Bact. 575 or V.Pth. 520 or consent of instructor. Miller.
Application of immunological principles to genetics; analytical procedures of blood typing; individual and species variation.

650. POPULATION GENETICS.

660. RESEARCH.
F.W.S.SSI. SSII.
Hollander, Miller, Peterson, Robertson, Sadanaga, Welshons.

690. SEMINAR.
Cr. 1. F. W. S.

698. SEMINAR IN CELL BIOLOGY.
History

The department offers introductory courses designed for all students as part of their general education, as a complement to or preparation for vocational training or as an introduction to further study in the field. The department offers major work in history with courses offered for advanced undergraduate work in American history, European history, Asian history, and history of science. Students majoring in history may substitute a second major in international relations for the two minors required in the College of Sciences and Humanities. See International Relations.

A pre-law undergraduate program may be pursued through a major in history. For a more complete statement, see Pre-professional Programs.

### Undergraduate Study

The department offers introductory courses designed for all students as part of their general education, as a complement to or preparation for vocational training or as an introduction to further study in the field. The department offers major work in history with courses offered for advanced undergraduate work in American history, European history, Asian history, and history of science. Students majoring in history may substitute a second major in international relations for the two minors required in the College of Sciences and Humanities. See International Relations.

A pre-law undergraduate program may be pursued through a major in history. For a more complete statement, see Pre-professional Programs.

### Graduate Study

The department offers major work for the degree Master of Arts in history or for the degree Master of Arts in the History of Science and Technology. Both programs are designed to enable a graduate to teach in high schools and junior colleges, enter the government service, or pursue a Ph.D. degree at another university.

In addition to the oral examination on a thesis, master's candidates must complete a written examination over two of the following fields: history of science, colonial and revolutionary America, 19th century United States, 20th century United States, ancient, medieval, modern Europe, England and Great Britain, Latin America, East Asia.

Open to graduate students for minor credit: Any 400-level course.

### COURSES PRIMARILY FOR UNDERGRADUATE STUDENTS

**201, 202, 203. WESTERN CIVILIZATION.** (2-0) Cr. 4 each. Yr.
- Social and cultural development of western civilization from the ancient Near East to the present emphasizing western economic and political ideas and institutions with historical change and continuity, basic methodology.

**221, 222, 223. HISTORY OF THE AMERICAN NATION.** (3-0) Cr. 4 each. Yr.

**325, 326, 327. HISTORY OF ENGLAND AND GREAT BRITAIN.** (4-0) Cr. 4 each. Yr.
- England to 1485: The story of the English people from the earliest times to 1485; the growth and development of English law, government, and society; the influence of the English people on the world; the rise of English power and the decline of British power in the world. Open to students for minor credit. Any 400-level course.

**340, 341. INTRODUCTION TO EAST ASIA.** (3-0) Cr. 4 each. Yr.
- A survey of political, economic, intellectual, cultural, and social developments in China, Japan, and Korea from earliest times to 1600. 341: Early impact of European influence on China, Japan, and Korea. The rise of nationalism in modern East Asia since World War II.

### INSTRUCTORS

- Philips B. Zaring, Ph.D.; Kenneth G. Madison, Ph.D.; Glenn O. Nichols, Ph.D.; James W. Whitaker, Ph.D.; Richard N. Kottman, Ph.D.
350, 351, 352. HISTORY OF LATIN AMERICA.  
(3-0) Cr. 3 each. Yr.  
Pre-Columbian civilization, discovery and Spanish and Portuguese colonization, colonial institutions, warfare and independence, the period of national development, social and economic progress, inter-American relations and international problems.

375. HISTORY OF AMERICAN AGRICULTURE.  
(3-0) Cr. 3. F.W.S.  
Major elements in American agricultural development from colonial times to the present.

382, 383, 384. ECONOMIC HISTORY OF THE UNITED STATES.  
(3-0) Cr. 3 each. Alt. Yr. Offered 1969.  
Prerequisite: 9 credits in history.  

400A, 400B, 400C. ANCIENT HISTORY: PRE-CLASSICAL MEDITERRANEAN WORLD.  
(3-0) Cr. 3 each. Alt. Yr. Offered 1970.  
Prerequisite: 9 credits in history.  
403A, 403B, 403C. ANCIENT HISTORY: THE CLASSICAL WORLD.  
(3-0) Cr. 3 each. Alt. Yr. Offered 1970.  
Prerequisite: 9 credits in history.  
404A, 404B, 404C. HISTORY OF MEDIEVAL WESTERN EUROPE.  
(3-0) Cr 3 each. Yr.  
Prerequisite: 9 credits in history.  
407. THE RENAISSANCE.  
(3-0) Cr. 3. F.  
Prerequisite: 9 credits in history.  
408. EUROPE: 1500 to 1648 (REFORMATION).  
(3-0) Cr. 3. S.  
Prerequisite: 9 credits in history.  
The Northern Renaissance, emergence of religious dissent, Protestant revolt, triumph and tragedy of Spain, victory of Calvinism, reaction and reform within Rome's Catholicism; religious wars and the emergence of France.

410A, 410B, 410C. CONTEMPORARY EUROPE.  
(3-0) Cr. 3 each. Yr.  
Prerequisite: 9 credits in history.  
411A, 411B. ECONOMIC HISTORY OF MODERN EUROPE.  
(3-0) Cr. 3 each. 411A: F; 411B: W.  
Prerequisite: 9 credits in history.  
416A, 416B. HISTORY OF RUSSIA.  
(3-0) Cr. 3 each. Yr.  
Prerequisite: 9 credits in history.  
421A, 421B. TUDOR-STUART ENGLAND.  
(3-0) Cr. 3 each. 421A: F; 421B: W.  
Prerequisite: 9 credits in history.  
430A, 430B, 430C. HISTORY OF SCIENCE.  
(3-0) Cr. 3 each. Yr.  
Prerequisite: 9 credits in history.  
431A, 431B. HISTORY OF ENGINEERING.  
(Engr. 431A, 431B.) See Engineering.

433. SCIENCE AND MODERN THOUGHT FROM 1500 TO PRESENT.  
(3-0) Cr. 3. S.  
Prerequisite: 9 credits in history.  
MODERN JAPANESE HISTORY.  
(3-0) Cr. 3. Alt. S. Offered 1971.  
Prerequisite: 341.  
462A, 462B, 462C. COLONIAL AMERICA.  
(3-0) Cr. 3 each. Yr.  
Prerequisite: 9 credits in history.  
THE JACKSONIAN MOVEMENT.  
(3-0) Cr. 3. S.  
Prerequisite: 9 credits in history.  
ORIGINS, DEVELOPMENT, AND SIGNIFICANCE OF JACKSONIAN DEMOCRACY IN DEFINING AND REVEALING THE NATURE OF AMERICAN ECONOMIC, SOCIAL, AND POLITICAL MORES AND INSTITUTIONS.

466. SECTIONAL CONFLICT AND THE CIVIL WAR.  
(3-0) Cr. 3.  
Prerequisite: 9 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: 9 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: 9 credits in history.
Major political, economic, and social developments of the nation from the advent of Progressivism to the present; emphasis on the growth of the government as a regenerative force in American society. 469A: Progressive Movement, home front during WWI, "red scare" and post-war reaction 469B. New economic era of the 1920's, depression, Hoover administration, the "New Deal" 469C: Wartime America, "Fair Deal," "Modern Republicanism," the "New Frontier" and the "Great Society"

471. SOCIAL AND INTELLECTUAL HISTORY OF THE UNITED STATES.
(3-0) Cr. 3. S.
Prerequisite: 9 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: 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) and social adjustments (law and order, religion, education, and culture).

477A, 477B, 477C. HISTORY OF THE UNITED STATES FOREIGN POLICY.
(3-0) Cr. 2 each. Yr.
Prerequisite: 9 credits in history.
American diplomatic history from 1775 to the present; emphasis on the penetration of American influence in those areas where the United States has exercised leadership 477A. Diplomacy of the American Revolution, struggle for neutrality, War of 1812; Monroe Doctrine, territorial and commercial expansion of the 1840's and 1850's, Civil War and post-Civil War expansionism. 477B: America's rise as a world power, Spanish American War, Far Eastern involvements, hegemony in the Caribbean; entry into World War I, peace making. 477C. Economic foreign policy in the 1920's; diplomacy of depression; entry into World War II; wartime diplomacy; the Cold War and its ramifications.

478. U.S.-SOVIET RELATIONS.
(3-0) Cr. 3. F.
Prerequisite: 9 credits in history.
Diplomatic issues between the two states from the inception of the Soviet Union to the present; emphasis on a) the period of non-recognition and American intervention in Russian Civil War, and b) the origins of the Cold War.

495. SPECIAL PROBLEMS.
Cr. 1 to 3 each time elected.
Prerequisite: Permission of department chairman. 9 credits in history.
Reading and reports on problems selected in conference with each student.
H Honors Program

*481A. 481B. DEVELOPMENT OF THE UNITED STATES CONSTITUTION.
(3-0) Cr. 3 each. 481A:F; 481B:W.
Prerequisite: 9 credits in history.
481A. Development to 1865. Constitutional heritage from England; colonial contributions to constitutional development; making the Constitution; problem of ratification; development of constitutional activities through Supreme Court decisions; effect of the Civil War on the Constitution. 481B: Since 1865. Constitutional significance of the World Wars, the Progressive movement and the New Deal.

COURSES PRIMARILY FOR GRADUATE STUDENTS, major or minor, open to qualified undergraduates

515. HISTORY OF TECHNOLOGY IN THE UNITED STATES.
(Engr. 615) See Engineering.

516. TECHNOLOGY IN DEVELOPING COUNTRIES.
(Engr. 661) See Engineering.

519. SEMINAR: HISTORY OF SCIENCE.
(3-0) Cr. 3 each.
A. Creativity in the Sciences and Humanities. Comparison of careers of well-known men in the sciences and humanities. Investigation of why choice of career is made and how originality is expressed.
B. Relation Between Science and Technology. Effects of technological change on scientific thought and of new scientific theories on material progress. Topics from prehistoric times to the present.

592. SEMINAR IN EAST ASIAN HISTORY.
(3-0) Cr. 3. S.
Topics vary each time offered.

593. SEMINAR IN AMERICAN HISTORY.
(3-0) Cr. 3 each.
Topics vary each time offered.

594. **SEMINAR IN EUROPEAN HISTORY.**
(3-0) Cr. 3 each.
Topics vary each time offered.
A Ancient History
B Medieval History.
C English History

D. Modern Europe.
E. European Diplomatic History
F. European Economic History.

598. **SPECIAL TOPICS IN HISTORY.**
Cr. 1 to 3 each time elected.
Prerequisite: permission of instructor.

**COURSE FOR GRADUATE STUDENTS, major or minor**

604. **RESEARCH IN HISTORY.**

**HOME ECONOMICS**

Helen R. LeBaron, Ph.D., Dean of Home Economics
Julia M. Faltinson, M.S., Associate Dean
Marguerite Scruggs, Ph.D., Assistant Dean for Graduate Study and Research
Lydia L. Inman, Ph.D., Coordinator of Resident Instruction
Irene Haynes Buchanan, M.S., Associate Professor
Jeannette M. Korslund, M.S., Placement Director

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 pass-fail basis only.

**COURSES PRIMARILY FOR UNDERGRADUATE STUDENTS**

150, 250, 350, 450. **COOPERATIVE WORK-STUDY PROGRAM.**
Cr. Arr. F.W.S.

400. **PROFESSIONAL RELATIONS.**
Cr. F.W.S.
Procedure in securing positions Employer-employee relationship.

420. **SENIOR SEMINAR.**
(1-0) Cr. 1 S.
A. Home Economics for General Education
B. Home Economics Journalism

440. **INTERDEPARTMENTAL SEMINAR.**
Cr. 1 to 3 F.W.S.
A. Issues
B. Field Trip.
C. International
D. Sophomore.
H. Honors

490. **SPECIAL PROBLEMS.**
Cr. Arr. F.W.S.
H. Honors

**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. F.W.S.

**HOME ECONOMICS EDUCATION**

Alberta D. Hill, Ed.D., Head of Department

*Professors: Hester Chadderdon, Ph.D.; Florence Fallgatter, D.Sc. (Emeritus); Marguerite Scruggs, Ph.D.*

*Associate Professors: Irene Beavers, Ph.D.; Eleanore L. Kohlmann, 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.; Frances Smith, Ph.D.*

*Instructors: Dorothy G. Brown, M.S.; Gladys M. Ebert, M.S.; Marcene Eshelman, M.S.; Sandra Fuhrman, B.S.; Helen E. Hansen, M.S.; Sandra N. Johnson, M.S.; June E. Kreutzkampf, B.S.; Pollie C. Malone, M.S.; Sue S. Reeves, M.S.*
Undergraduate Study

For undergraduate curriculum in home economics education leading to the degree Bachelor of Science, see Home Economics Education Curriculum.

The curriculum in home economics education 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 on selection and the College of Education Committee on Academic Standards in order to advance to the teacher education program or preparation for the 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 major work for the degrees Master of Science and Doctor of Philosophy 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. OBSERVATION AND METHODS OF TEACHING HOME ECONOMICS. (3-3) Cr. 4. F.W.S. Prerequisite: Educ. 305, admission into teacher preparation program. Responsibilities of the homemaking teacher in applying principles of learning and of adolescent development to instruction. Philosophy of home and family life education. Guided observation of teaching. Field trips to typical homemaking departments.


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 socio-economic 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.

417. SUPERVISED EXPERIENCES IN HOME ECONOMICS EDUCATION. Cr. 3. F.W.S. Prerequisite: Concurrent registration in H. Ed. 407. Supervised professional experiences in educational programs in home economics.

490. SPECIAL PROBLEMS. Cr. arr. F.W.S. SSI. SSII. H. Honors
386 Courses and Programs

COURSES PRIMARILY FOR GRADUATE STUDENTS, major or minor, open to qualified undergraduates

500. SHORT COURSE.
Cr. Arr. SSI, SSII.
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. SS.
Prerequisite: Permission or Instructor.
Concentrated group study of problems in fields of home economics education. Sections offered will vary from year to year.
A. Adult Education
B. Administration.
D. Evaluation.
F. Supervision. Hill, Thomas.

507. TRENDS IN TEACHING HOME ECONOMICS.
(2 or 3-0) Cr. 2 or 3. SS.
Prerequisite: Teaching experience.
Developments in organization and methods of teaching home economics. The vocational homemaking program, organization, curriculum and methods.

590. SPECIAL TOPICS.
Cr. arr. F.W.S.SSI. SSII.
Prerequisite: 406.
A. Adult Education. Beavers.
B. Administration.
D. Evaluation.
F. Supervision. Hill, Thomas.
G. General.

COURSES FOR GRADUATE STUDENTS, major or minor

605. HOME ECONOMICS CURRICULA.
(3-0) Cr. 3. F.SSI.
Prerequisite: 15 credits in education and teaching experience or permission of instructor. Kohlmann.
Curriculum building applied particularly in home economics education. Sections offered will vary from year to year.
A. Adult Education. Beavers.
B. Evaluation.
D. Supervision and Administration. Hill, Thomas.
E. Special.

606. EDUCATIONAL LEADERSHIP AND SUPERVISION IN HOME ECONOMICS.
(3-0) Cr. 3. S.SS.
Prerequisite: 5 credits in graduate courses in home economics education. Hill.
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.SS.
Prerequisite: 408 or experience in adult education, 8 credits in psychology, permission of instructor. 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. F.W.S.SSI, SSII.

611. DESIGN AND PHILOSOPHY OF RESEARCH IN HOME ECONOMICS EDUCATION.
(3-0) Cr. 3. F.SSI.
Prerequisite: Credit or classification in Educ. 552 or Stat. 401. Fanslow.
Application of logic and the scientific method to problems in home economics education. Survey, field, experimental and historical methods of research. Needed research in home economics education. Planning a research study. Understanding of research reports.

612. EVALUATION IN HOME ECONOMICS.
(3-0) Cr. 3. W.SS.
Prerequisite: 12 credits in education or permission of instructor.
Selection and construction of evaluation devices. Their use and interpretation in home economics programs.

614. RESEARCH.
F.W.S.SSI, SSII.
Beavers, Fanslow, Hill, Kohlmann, Scruggs, Thomas.

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 faculty 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 their freshman year, 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 occasionally a student with a lower grade-point average may be admitted.

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 pass-fail basis.

An Honors seminar is assigned a registration listing according to the college affiliation of the instructor in charge; unless otherwise indicated, all Honors students, regardless of their college, are eligible to enroll in any seminar if space is available. Honors seminars are found under the following registration listings:

- Ag. 499H
- D.St. 301H, 302H, 303H
- Engr. 190H
- H.Ec. 440H

Honors courses open only to Honors Program students, and Honors sections of regular courses, are offered by some departments. Those listed in this catalog include Phys. 371H, 372H, and 373H; Psych. 230H, 333H, and 490H; 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, Old Botany.

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.; Clinton F. Hodges, Ph.D., M. LeRon Robbins, Ph.D.

Undergraduate Study

For undergraduate curriculum in horticulture leading to the degree Bachelor of Science, see Horticulture, Curriculum

The curriculum in horticulture is designed for students interested in fruit growing, vegetable growing, flower growing, vegetable and flower seed production, nursery management, landscape nursery management, arboriculture and turfgrass management. Horticulture is a career for city as well as rural youth. A farm background is not necessary.

The four-year curriculum has six areas of specialized training: (1) fruit crops, (2) vegetable crops (3) floriculture, (4) nursery management, (5) arboriculture and (6) turfgrass
management. The curriculum is designed to prepare the student for work as an owner, operator or manager of an orchard, vegetable or flower growing enterprise, florist shop, nursery, or arboriculture firm; field man or production supervisor for a canning company, seed company, nursery or florist; plant breeder for a seedman or canner; turfgrass consultant for golf courses, playing fields and parks; research worker in commercial work, such as a canning company, seed company, nursery or floral enterprise; utility line clearance foreman; supervisor of tree care in parks, highways, college campuses or grounds of other public institutions; teacher, research and extension worker in a college or university and in government work; or for graduate work leading to advanced degrees in horticulture and related fields.

The curriculum provides a liberal allowance of elective credits to be filled with courses selected by the student.

### Graduate Study

The department offers major work for the degrees Master of Science and Doctor of Philosophy in horticulture with the option of specializing in fruit crops, vegetable crops, floriculture, nursery crops, arboriculture and turfgrass, and minor work to students taking major work in other departments.

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, arboriculture or turfgrass should present the equivalent of 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, 446, 447, 467, 490, 491, 492, 493.

### COURSES PRIMARILY FOR UNDERGRADUATE STUDENTS

110. **INTRODUCTION TO HORTICULTURE.**
(1-0) Cr. R. F.
Introduction of first-year students to horticulture field, 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.; B: (0-2) Cr. 1. F.W.S.
Horticulture in daily living, plant growth, environment, propagation, cultivation, pruning, irrigation, protection, harvesting, quality control and selection, home grounds development and maintenance laboratory optional but recommended.

146. **HOME FLORICULTURE.**
(0-4) Cr. 2. F.W.S.
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 growing plants under glass, greenhouse construction and equipment.

164. **VEGETABLE CROPS.**
(3-0) Cr. 3. S.
Principles of vegetable production Culture of the more important vegetables.

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. SS.
Culture and use of important garden flowers including annuals, perennials, bulbs, flowering vines, rock and water garden plants.

247A. 247B. **FLORAL DESIGN.**
A: (1-2) Cr. 2. F.W.S. B: (1-4) Cr. 3. Alt. W.
Offered 1971.
Prerequisite: A: Not open to horticulture majors without permission of the instructor. B: Open only to horticulture students.
Principles, mechanics and uses of flower arrangements; conditioning and preparation of floral arrangement material; exhibiting and judging of flowers and flower arrangements.
306. LANDSCAPE SERVICE.  
(2-2) Cr. 3. F.  
The applied aspects of establishment, maintenance, and pest control relevant to turfgrasses and woody ornamentals used in landscape operations.

314. TURFGRASS SCIENCE I.  
(Agron. 314) (3-0) Cr. 3. F.  
The grass plant: Structure, growth, and physiology in relation to the physical environment - soil, water, light, and fertility.

316. NURSERY MANAGEMENT.  
(2-2) Cr. 3. S.  
Prerequisite: 214.  
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. ORCHARDING.  
(2-2) Cr. 3. F.  
Prerequisite: 114.  
Varieties, pest control, harvesting, grading, packing and storage of orchard crops.

324. GRADING AND JUDGING HORTICULTURAL PRODUCTS.  
(0-4) Cr. 1 each. F.W.  
Open to senior students only. Grading and judging horticultural crops and products, requirements of produce inspection services: staging horticultural exhibits.

344, 345. HERBACEOUS ORNAMENTAL PLANTS.  
(2-0) Cr. 2. F.W.  
Prerequisite: 114A.  
344. Nomenclature, derivation, development and classification of annuals, biennials, suffrutescent 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 II.  
(Agron. 413) (3-0) Cr. 3. S.  
The grass plant and its relationship to the biological environment: weeds, insects, soil microorganisms, and pathogens.

414. MARKETING HORTICULTURAL PRODUCTS.  
(4-0) Cr. 4. Alt. W. Offered 1970.  
Prerequisite: 114.  
Areas of production of horticultural crops, market intelligence, inspection, transportation, storage, price trends, agents of distribution, market news service, foreign markets, cooperative markets.

422. ADVANCED ORCHARDING.  
(2-2) Cr. 3. Alt. S. Offered 1971.  
Prerequisite: 321.  
Propagation, planting, pruning, maintenance, physiology of growth and storage of orchard crops.

446, 447. ADVANCED FLORICULTURE.  
Prerequisite: 446: 154, 244; 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 1971.  
Prerequisite: 214.  
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.

490. SYSTEMATIC HORTICULTURE I.  
(2-2) Cr. 3. Alt. F. Offered 1969.  
Origin, identification, classification, description, and genetics of woody ornamental plants.

491. SYSTEMATIC HORTICULTURE II.  
(2-2) Cr. 3. Alt. W. Offered 1970.  
Origin, identification, classification, description, and genetics of conservatory plants.

492. SYSTEMATIC HORTICULTURE III.  
(2-2) Cr. 3. Alt. F. Offered 1970.  
Origin, identification, classification, description and genetics of vegetable crops.

493. SYSTEMATIC HORTICULTURE IV.  
(2-2) Cr. 3. Alt. W. Offered 1971.  
Origin, identification, classification, description and genetics of fruit crops.

COURSES PRIMARILY FOR GRADUATE STUDENTS, major or minor, open to qualified undergraduates.

510. SPECIAL TOPICS.  
Cr. arr.  
Prerequisite: A major or minor in horticulture.

514. HORTICULTURAL SCIENCE.  
(3-0) Cr. 3. Alt. W. Offered 1971.  
Prerequisite: 3 credits in genetics, 3 credits in plant physiology. Agron. 354, Stat. 201A.  
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 1970.  
Prerequisite: Gen. 301, Weigle.  
A study of genetic systems and breeding techniques or methods that are of particular value to the improvement of horticultural plants.

COURSES FOR GRADUATE STUDENTS, major or minor.

600. RESEARCH.  
Cr. 1-11. F.W.S.SS1.SSII.  
Bauske, Buck, Denisen, Hodges, Kelley, Mahlstede, Sherwood, Weigle.

604. GRADUATE CONFERENCE.  
Cr. 1 each time elected. F.W.S. Denisen.

690. ADVANCED SYSTEMATIC HORTICULTURE I.  
(2-2) Cr. 3. Alt. F. Offered 1969.  
Prerequisite: 490 or 15 credits in advanced horticulture or botany.  
Identification, classification, propagation, and origin of woody ornamental plants.
Courses and Programs

691. ADVANCED SYSTEMATIC Horticulture II.
(2-2) Cr. 3. Alt. W. Offered 1970.
Prerequisite: 491 or 15 credits in advanced horticulture or botany.
Identification, classification, propagation, and origin of conservatory plants.

692. ADVANCED SYSTEMATIC Horticulture III.
(2-2) Cr. 3. Alt. F. Offered 1970.
Prerequisite: 492 or 15 credits in advanced horticulture or botany.
Classification, origin, and genetics of vegetable crops.

693. ADVANCED SYSTEMATIC Horticulture IV.
(2-2) Cr. 3. Alt. W. Offered 1971.
Prerequisite: 493 or 15 credits in advanced horticulture or botany.
Classification, description and nomenclature of temperate and sub-tropical fruits.

HOUSING

Advisory Committee: Margaret I. Liston, Ph.D., Chairman; Thomas A. Barton, M.L.A.; Raymond D. Reed, M.Arch.; Clair B. Watson, M.F.A.

Major 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. Minor work is offered to students taking major programs in other areas.

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:

- Applied Art: 261\textsuperscript{1}, 262\textsuperscript{1}, 361\textsuperscript{1}, 362\textsuperscript{1}, 464\textsuperscript{1}, 465\textsuperscript{1}, 467\textsuperscript{1}, 490E, 590E, 614.
- Architecture: 355\textsuperscript{1}, 361\textsuperscript{1}, 362\textsuperscript{1}, 363\textsuperscript{1}, 371\textsuperscript{1}, 460\textsuperscript{1}, 514, 515, 516, 543\textsuperscript{1}, 590, 610, 611, 612, 613.
- Family Environment: 308\textsuperscript{1}, 340\textsuperscript{1}, 412\textsuperscript{1}, 415\textsuperscript{1}, 445\textsuperscript{1}, 446\textsuperscript{1}, 485\textsuperscript{1}, 488\textsuperscript{1}, 521, 504B, 505A, 505B, 604B, 690B.
- Landscape Architecture and Urban Planning: 210\textsuperscript{1}, 361\textsuperscript{1}, 383\textsuperscript{1}, 492\textsuperscript{1}, 510; 550 A, D, E, F, G, H, I, J; 561, 562, 571, 600, 620.

\textsuperscript{1}Graduate credit not available.
\textsuperscript{2}Graduate credit not available to majors in this department.
HYGIENE

Gail McClure Proffitt, M.D., Head of Department

Professor: John G. Grant, M.D.

Undergraduate Study

For the Student Health Service of the Department of Hygiene, see Health Service.

The Department of Hygiene offers such training and instruction as will enable students to maintain high health standards for themselves and the community in which they live.

COURSES PRIMARILY FOR UNDERGRADUATE STUDENTS

104. HEALTH EDUCATION.
   A: (3-0) Cr. 3. F.W. B: (0-2) Cr. 1. F.W.
   A Personal, family and community health
   B First aid laboratory required for women physical education majors

304. SCHOOL HEALTH PROBLEMS.
   (3-0) Cr. 3. S.

IMMUNOBIOLOGY

Merlin L. Kaeberle, Chairman, Advisory Committee

Major work in immunobiology is offered for the degrees Master of Science and Doctor of Philosophy under a cooperative arrangement with several departments: Agronomy, Animal Science, Bacteriology, Biochemistry and Biophysics, Botany and Plant Pathology, Dairy and Food Industry, Food and Nutrition, Forestry, Genetics, Horticulture, Poultry Science, Veterinary Clinical Sciences, Veterinary Microbiology and Preventive Medicine, Veterinary Pathology, 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 immunogenetics, physiology of antibody formation, immunofluorescence microscopy, immunochemistry, immunopathology, immunodiagnostics, immunotherapy, cellular response in antibody formation, kinetics of antigen-antibody reactions, 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 Advisor 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 completed 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.

It is strongly recommended that immunobiology majors include the following core of courses:

Bact. 575 or Vet. Micr. 520
B. & B. 311, 404, 405 or 501, 502, 503 and 511, 512
Stat. 401, 402

A student's program will include a number of the following supporting courses as appropriate:

An.S. 650
Bact. 509, 601, 603, 615, 645, 660, 675, 678
B. & B. 578
Gen. 605, 620, 646

Po.S. 601
Stat. 411
Vet. Micr. 625, 626, 629
Zool. 520
INDUSTRIAL ADMINISTRATION

W. H. Thompson, Ph.D., Chairman of Department


Associate Professors: Lester L. Hoover, Ph.D., C.P.A.; Patrick H. Mullin, C.P.A., J.D.


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 Humanities, Curriculum

The Department of Industrial Administration provides training for those who are interested in business and industry, having as their goals either private business enterprise or ultimate business management positions. It is the purpose of the department to provide interrelated training in the basic recognized business areas of accounting (managerial, cost and tax), business law, business forecasting, business organization, finance, industrial risks, marketing and procurement, regulation of business, transportation, physical distribution, and traffic management. The Departments of Economics, Industrial Engineering and Psychology offer supplementary instruction in the areas of industrial relations, employer-employee relations, production management and personnel supervision.

The department offers preparation for the study of law by completion of three years of this curriculum, followed by one year in a recognized college of law, after which the degree Bachelor of Science with a major in industrial administration will be awarded by Iowa State University. Those interested in this cooperative program should contact the head of the department early in the sophomore year to assure an appropriate sequence of course work.

In cooperation with the Department of Architecture a program of study is provided for those who are interested in business as related to the building industries. This program leads to the degree Bachelor of Science, with a major in industrial administration and minor in architecture. For particulars, the head of either department should be consulted.

In cooperation with the Department of Institution Management, College of Home Economics, a program of study is provided for those students interested in business as related to the food service industry. Students will prepare for positions in restaurant management, college food and housing administration, and other similar managerial positions. For particulars, the head of either department should be consulted.

COURSES PRIMARILY FOR UNDERGRADUATE STUDENTS

150. INTRODUCTION TO INDUSTRIAL ADMINISTRATION.
   (4-0) Cr. 4. F.W.S.SI. SSII.
   The study of business as a part of general undergraduate education with emphasis on the business firm as a social institution and as a functioning unit within the economic, social and political environment in which it is managed and in which it operates

340. INDUSTRIAL MARKETING I.
   (3-0) Cr. 3. F.W.S.SS.
   Prerequisite: Econ. 242.
   Marketing functions, institutions and policies as applied to the industrial market

350. BUSINESS FINANCE.
   (3-0) Cr. 3. F.S.SS.
   Prerequisite: Econ. 241, one course in accounting.
   Principles of financial organization and management. Types of corporate securities; financing and management of new corporations and reorganizations

355. REAL ESTATE FINANCE.
   (B. Cr. 355) (3-0) Cr. 3. F.S.
   Prerequisite: Arch. 343 or I.Ad. 350.
   An analysis of current real estate problems and practices from the standpoint of the businessman and the property owner. The financial,
economical and social aspects of real estate investment decisions are emphasized, with considerable attention to impact upon the construction industry

360. PRINCIPLES OF TRANSPORTATION. (3-0) Cr. 3. F.W.S.
Prerequisite: Econ. 242.
Historical development and current role of transportation in the United States. An analysis of the economic problems and public policy pertaining to all agencies of transportation with emphasis directed toward the railroad industry.

365. BUSINESS LAW I. (3-0) Cr. 3. F.W.S.
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 PUBLIC REGULATION. (3-0) Cr. 3. F.W.
Prerequisite: Credit or classification in Econ. 242.
Ownership and management organization, relationship between government and business.

*371. INDUSTRIAL ACCOUNTING. (3-0) Cr. 3. F.W.S.
Survey of 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.

*372A, 372B, 372C. GENERAL ACCOUNTING. Cr. 4. 372A: (2-3) S.SSI; 372B: (4-0) F.W.; 372C: (3-2) F.
372A For students in engineering Emphasis upon managerial control aspects 372B For students in home economics Emphasis upon food service and institutional applications 372C For students in dairy and food industries Emphasis upon accounting applications to dairy enterprises.

*384. ACCOUNTING I. (2-4) Cr. 4. F.W.S.SSI.
Introduction to theory and procedure of general accounting. Emphasis upon development of accounting reports on an accrual basis through transaction analysis and summarization. Introduction to controlling accounts and special journals. Designed primarily for students who contemplate completing the basic accounting sequence.

385. ACCOUNTING II. (3-0) Cr. 3. F.W.S.SSI.
Prerequisite: 384. or 372 and permission of instructor.
Capital and surplus analysis introduction to valuation concepts as they relate to receivables, inventories and fixed assets, partnership accounting techniques and problems.

386. INTERMEDIATE ACCOUNTING. (3-0) Cr. 3. F.W.S.SSI.
Prerequisite: 385.
Accounting functions and introduction to accounting theory, application of valuation principles, interpretation of financial statements.
466. AIR AND WATER TRANSPORTATION. (3-0) Cr. 3. Alt. S. Offered 1971.
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.
Prerequisite: Econ. 242.
Nature of the public utility concept. Theories of valuation and rate of return, plant operation and utilization, 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: 360, 463.
Research and discussion on contemporary problems in the field of transportation, particularly in the areas of (a) coordination and consolidation of the major agencies which comprise the transportation system, and (b) changing regulatory policies of the state and federal government and their impact upon the nation's economy.

470. BUSINESS FORECASTING. (3-0) Cr. 3. F.W.S.S.
Prerequisite: 350, 384, Econ. 242.
Methods employed in estimating the probable degree and direction of business change with a view to reducing business risk.

474. ADVANCED BUSINESS FINANCE. (3-0) Cr. 3. W.
Prerequisite: 350, 384.
Promotion and expansion of business enterprise. Procedure and planning of the internal financial control of business. Field trip.

477. BUSINESS FINANCE SEMINAR. (3-0) Cr. 3. S.
Prerequisite: 350, 445, 474.
A consideration of 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. (2-4) Cr. 4. F.W.S.S.
Prerequisite: 372A or 372C or 384.
Elements of cost in industrial accounting, preparation of cost reports, job order and process cost accounting methods, introduction to standard costs. Field trip.

481. ADVANCED COST ACCOUNTING. (3-0) Cr. 3. S.
Prerequisite: 386, 480.
Development of standard production cost systems, including typical managerial reports. Study of distribution costs, manufacturing budgets, incremental profit and profit volume analysis. Introduction to direct costing. Field trips.

488. SALES MANAGEMENT. (3-0) Cr. 3. F.
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. INDUSTRIAL RISKS. (3-0) Cr. 3. F.W.S.S.
Prerequisite: 365.
Risks of modern industry, shifting of industrial risks through the insurance technique. Characteristics of mutual and stock companies. Estimations of insurable costs.

495. ADVANCED ACCOUNTING I. (3-0) Cr. 3. F.
Prerequisite: 386.

496. ADVANCED ACCOUNTING II. (3-0) Cr. 3. W.
Prerequisite: 386.
Principles and procedures involved in the accounting for the expansion, contraction and reorganization of business units. Branch operations, consolidated financial statements, purchase of business units, pooling of interests, quasi reorganization, reorganization. Field trips.

497. AUDITING. (3-0) Cr. 3. W.
Prerequisite: 495.
Internal control procedures in modern business, the development of auditing standards and procedures as applied by Certified Public Accountants, a review of internal auditing activities. Field trips.

498. ACCOUNTING SEMINAR. (3-0) Cr. 3. S.
Prerequisite: 481, 496, 497.
An integration and expansion of accounting theory and practice as they relate to the operation of both the controllership function in business and the public accounting profession. Field trips.

499. SPECIAL PROBLEMS. Cr. 1 to 5 each time elected. F.W.S.SI. SIII.
Prerequisite: Senior classification, permission of department head.

*Only one of the following courses may count toward graduation: 371, 372, 384.*
INDUSTRIAL ENGINEERING

Joseph K. Walkup, B.M.E., I.E., Head of Department


Associate Professors: K. L. McRoberts, Ph.D.; Geraldine M. Montag, Ph.D.; Clifford E. Smith, Ph.D.; Victor M. Tamashunas, M.S.

Assistant Professors: John C. Even, Ph.D.; George E. Lamp, Ph.D.; Donald E. Grant, B.S.; Herbert A. Harmison, Jr., M.S.; Robert D. Love, M.S.; Loran E. Mohr, M.S.; James C. Sprague, M.S.; Franklin K. Wolf, M.S.

Instructors: Harold M. Hoover, Jr., M.S.; Edwin L. Hullander, B.S.; Christopher J. Joannides, B.S.; Stanley Rajtora, B.S.; John K. Willoughby, M.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 College of Engineering, Cooperative Programs.

Graduate Study

The department offers major work for the degree Master of Science in industrial engineering and in engineering valuation and for the degree Doctor of Philosophy in engineering valuation and minor work to students taking major 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.

Open to graduate students for minor credit only: 312, 313, 361, 404, 407, 416, 421, 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.
   Prerequisite: Credit or classification in Math. 101 or 101C.
   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. 105.
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: 3 credits of mathematics. Engineering students required to have credit in 105 or 108.
Elementary programming techniques including the use of interactive 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. 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.

283. 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 291.

304. ANALYSIS FOR ENGINEERING ECONOMY.
(3-0) Cr. 3. F.W.S.
Derived of formulas used in theory of investment of engineering enterprises, economy studies applied to original and alternative investments in engineering, replacement problems, relationships to accounting.

312. 313. INDUSTRIAL OPERATIONS RESEARCH.
(4-0) Cr. 4 each. 312: F.W.; 313: W.S.
Prerequisite: 312: Math. 304; 313: 312, 361.
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 tendencles, 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 co-ordination of an industrial organization.

361. QUANTITATIVE METHODS FOR INDUSTRIAL ENGINEERING. (3-0) Cr. 3. F.W.
Prerequisites: 250 or 351; Stat. 201B.
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.

404. ENGINEERING ECONOMY.
(2-2 or 3-0) Cr. 3. F.W.S.
Prerequisite: Econ. 242, 1 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 valution 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) Cr. 3. F.S.
Prerequisite: 250 or 351.
Principles of accident prevention in industry; training for and selling safety. Safe machine design and guarding. Industrial compensation and safety legislation.

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. Employee instruction, training, education, and evaluation emphasized.
441. INDUSTRIAL ENGINEERING DESIGN I.
(3-4) Cr. 5. F.W.
Prerequisite: 273, 312, 404.
Operations, machines and processes required for typical manufacturing problems; selection, specification and layout of equipment and plant facilities, balancing schedules, budget preparation.

442. INDUSTRIAL ENGINEERING DESIGN II.
(3-4) Cr. 5. W.S.
Prerequisite: 313, 441.
The development and application 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. 8.
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.
(1-4) Cr. 3.
Prerequisite: 351, 404.
Information feedback characteristics of industrial systems; interaction of organization structure, policies and time in the success of an enterprise; relationships between flow of information, money, materials, orders, person-

COURSES PRIMARILY FOR GRADUATE STUDENTS, major or minor, open to qualified undergraduates

500. ENGINEERING PSYCHOLOGY.
(Psych. 500) See Psychology.

504. ADVANCED ENGINEERING ECONOMY.
Cr. 3 to 5. F.W.S.
Prerequisite: 404, 3 credits in accounting.
Advanced engineering economic analysis; engineering, financial and intangible factors influencing management decisions for expenditure of funds. Applications of capital recovery and physical plant replacement theories.

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-rationed 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 rate, 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, condemnation, sales, estate settlements, and for determining fixed capital costs.

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. 8.
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. 8.
Prerequisite: 424.
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;
SAMPLING INSPECTION.
(Stat. 531) See Statistics.

532. INDUSTRIAL STATISTICS;
DESIGN OF EXPERIMENTS.
(Stat. 532) See Statistics.
539. OPERATIONS RESEARCH METHODS. (Stat. 539) See Statistics.


545. ADVANCED INDUSTRIAL ENGINEERING. 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.

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, 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.

594. SPECIAL TOPICS. Cr. 1 to 5 each time elected. F.W.S.
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: 581, 608; 681B: 581.
A. Utility rates, property valuation and depreciation
B. Legal relations in industry

690. SEMINAR. Cr. R.F.W.S.

694. ENGINEERING VALUATION RESEARCH. Cr. 1 to 5. F.W.S.

695. INDUSTRIAL ENGINEERING RESEARCH. Cr. 1 to 5. F.W.S.

INDUSTRIAL RELATIONS
Edward B. Jakubauskas, Ph.D., Chairman, Advisory Committee

Graduate Study
Major work in industrial relations is offered for the degree Master of Science. This is a multi-disciplinary degree offered under a cooperative arrangement by the Departments of Economics, Psychology and Sociology. Minor work is offered to students taking major work in other areas of study.

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. For administrative purposes the student will be in the department of his major professor.

Each student will select two of the three cooperating disciplines (economics, psychology, sociology) as a major field in industrial relations. Approximately two-thirds of course credits (including thesis) will comprise the major field.

The remaining discipline (or an approved alternative discipline such as industrial engineering or political science) will, together with Stat. 401 and 402, constitute a minor field. Approximately one-third of a student’s course work will comprise the minor field.

The language requirement may be waived upon recommendation of the chairman of the Advisory Committee.

The Verbal and Quantitative Aptitude Tests of the Graduate Record Examination are required of all applicants to the Industrial Relations Program.

Courses appropriate for graduate students majoring or minoring in industrial relations include those listed (for course description and credits see departmental listings):

Econ. 590, 591, 592, 593, 594, 595; Psych. 501, 550, 551, 580; Soc. 401, 410, 480, 570, 698J; I. E. 500, 522, 571, 581, 594; Pol. S. 520, 526, 527, 580B.

Additional courses appropriate for graduate students minoring in industrial relations include those listed (for course description and credits see departmental listings):

Econ. 441, 445; Psych. 440, 451; Soc. 600, 601, 698A; I. E. 424, 425, 426, 448, 475, 480; Pol. S. 420, 421, 422.

INSTITUTION MANAGEMENT

Marjorie M. McKinley, Ph.D., Head of Department

Professor: Grace M. Augustine, Ph.D. (Emeritus)
Associate Professor: Geraldine M. Montag, Ph.D.
Assistant Professors: Thomas A. Beattie, M.Ed.; Grace M. Boyd, M.S.; Doris J. Hittle, M.A.; Louise M. Mullan, M.S.; Grace E. Olsen, M.S.; Thomas E. Walsh, M.A.
Instructors: Janice T. Dana, M.S.; 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. Students may elect one of three majors: college food and housing administration, 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 restaurant management provides, in addition to a general education, basic work to prepare men and women for supervisory and executive positions in the restaurant industry. The fundamentals of large quantity food production and business management are presented.

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 lunch units and to become area and state school lunch supervisors. 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 and university residence halls 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 major work for the degree Master of Science 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 departments 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: 470, 484, 485, 487, 488, 489, 490, 500.

COURSES PRIMARILY FOR UNDERGRADUATE STUDENTS

287. INTRODUCTION TO INSTITUTION MANAGEMENT.
(2-0) Cr. 2. W.
Orientation to the scope of the food and housing service industry and various aspects of management. Field trips required.

380. QUANTITY FOOD PRODUCTION MANAGEMENT.
(2-6) Cr. 4. F.W.S.SS.
Prerequisite: F. & N. 208 or 214.
Standard methods of food production in quantity, menu planning for institutions, determination of food costs, experience in food service advance reservation with department head required.

400. STUDY TOUR.
Prerequisite: Junior or senior institution management classification.
Study tour of quantity food service and house administration units and of related industries.

404. SEMINAR.
(2-0) Cr. 2. S.
Prerequisite: Senior classification.

470. QUANTITY FOOD PRODUCTION METHODS.
Cr. arr. SSI. or SSII.
Prerequisite: A college course in principles of food preparation.
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 I.M. 380 for Iowa State Institution Management and Food and Nutrition majors.

484. PURCHASING.
(3-3) Cr. 4. F.W.
Prerequisite: 380 or F. & N. 303.
Principles and methods of buying food for various types of quantity food service, with emphasis on specifications and factors affecting quality. Field trips required.

485. EQUIPMENT.
(3-3) Cr. 4. S.SS.
Prerequisite: 380 or classification in 380.
Selection and arrangement of equipment and furnishings for food departments 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.
A and B, Food Service Management.
Prerequisite: 484, 485, 488.
C and D, Housing and Social Program Management.
Prerequisite: 485A, 486B, 489.
Only for students majoring in college food and housing administration.
A and C, Lecture - Discussion.
International Service Programs

B and D. Laboratory.
Analysis and interpretation of management functions. Emphasis on interpersonal relations. Experience in food and housing departments of Iowa State University, Memorial Union, and approved establishments.

487. ORGANIZATION AND MANAGEMENT.
(3-0) Cr. 3. S.SS.
Prerequisite: 380.
Principles of organization and management, financial procedures and controls applicable to food service and housing organizations.

488. PERSONNEL MANAGEMENT IN INSTITUTIONS.
(3-0) Cr. 3. F.S.
Prerequisite: 487.
Principles of personnel management as related to institution management.

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. S.
Prerequisite: 380, F. & N. 411, permission of department head.
Experimental approach to methods in quantity food production as related to time factor, in stitution equipment, and proportions of ingredients.

585. CATERING.
(2-6) Cr. 4. F.W. Alt. SSI.
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.M. 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.

614. RESEARCH.
F.W.S.SSI. SSI. McKinley, Montag.

INTERNATIONAL SERVICE PROGRAMS

Ex-officio: Joe Darnall, Ph.D.

The international service programs are designed for students who are interested in international relations as a field for academic study and for those interested in training for employment overseas in the foreign service or other government agencies, in foreign trade sections of business and industry, or in technical aid and development programs abroad. Students may participate in international service programs in any one of three colleges: Agriculture, Engineering or Home Economics. Those students majoring in anthropology, economics,
foreign languages, history, journalism, political science or sociology in the College of Sciences and Humanities may also major in international relations.

Any student who wishes to enter the program in agriculture, engineering or home economics must file an application with the chairman of the International Service Programs Committee. The student and his adviser are responsible for stating on the senior requirement sheet that he is completing the program. The student's completion of the program requirements must be certified to the Registrar by a member of the International Service Programs Committee representing the student's college. Any student in the College of Sciences and Humanities who wishes to major in international relations must apply to the chairman of the International Service Programs Committee.

International Service Program in the College of Agriculture

Students in agriculture remain in their chosen curriculum and use their electives to meet program requirements for international service in agriculture. The requirements are:

<table>
<thead>
<tr>
<th>Course Area</th>
<th>Credits</th>
</tr>
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<tbody>
<tr>
<td>Modern Foreign Languages</td>
<td>21 Credits</td>
</tr>
<tr>
<td>Political Science</td>
<td>12 credits</td>
</tr>
<tr>
<td>Economic</td>
<td>6 credits</td>
</tr>
<tr>
<td>Anthropology</td>
<td>3 credits</td>
</tr>
<tr>
<td>World Resources</td>
<td>6 credits</td>
</tr>
</tbody>
</table>

Modern Foreign Languages
- All credits must be in a single language.

Political Science
- Pol S 351, 352 World Politics and International Organization 6 credits
- Pol S 422 International Law 3 credits
- Political Science elective 3 credits

Economics
- Econ 455 International Economics 3 credits
- Economics elective 3 credits
- (Econ 512 Agrarian Reform and Economic Development, recommended)

Anthropology
- Anthro 218 Introduction to Cultural Anthropology 3 credits

World Resources
- Select from:
  - Agron 406 Climates of the Continents (3 cr)
  - Agron 483 World Soil Resources (3 cr)
  - Geog 201 World Geography (3 cr)
  - Geog 322 Economic Geography (3 cr)
- Total 48 credits

A notation will appear on transcripts of students who complete all of the above requirements. 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 persons in agriculture should consult their advisers.

International Service Program in the College of Engineering

Students in the program must meet the following minimum requirements:

<table>
<thead>
<tr>
<th>Course Area</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Psychology</td>
<td>3 credits</td>
</tr>
<tr>
<td>Industrial Administration</td>
<td>3 credits</td>
</tr>
<tr>
<td>Earth Science</td>
<td>6 Credits</td>
</tr>
</tbody>
</table>

Psychology
- Psych 101 General Psychology I 3 credits

Industrial Administration
- I.Adm. 365A Business Law I 3 credits

Earth Science
- Geog. 201 World Geography 3 credits
- Geog 322 Economic Geography 3 credits
International Service Programs

Political Science
- Pol S 215 American Government 3 credits
- Pol S 351, 352 World Politics and International Organization 6 credits
Select from
- Pol S 340 Politics of Developing Nations (3 cr)
- Pol S 440 British and Commonwealth Governments (3 cr)
- Pol S 442A Governments of China and Japan (3 cr)
- Pol S 442B Governments of India, Pakistan and Southeast Asia (3 cr)
- Pol S 443A Governments of Latin America (3 cr)
- Pol S 443B Recent Latin-American Politics (3 cr)
- Pol S 445 Politics of the Middle East (3 cr)
- Pol S 446A, 446B Governments of Africa (3 cr)
- Pol S 451 Asia in World Affairs (3 cr)
- Pol S 458 United States Foreign Policy (3 cr)

Economics
- Econ 241, 242 Principles of Economics 6 credits
- Econ 455 International Economics 3 credits

History
Select from
- Hist 327 History of England and Great Britain (3 cr)
- Hist 341 East Asia in Modern Times (3 cr)
- Hist 410A, 410B Contemporary Europe (3 cr)
- Hist 416A, 416B, 416C History of Russia (3 cr)
- Hist 443 Modern Japan (3 cr)
- Hist 350, 351, 352 History of Latin America (3 cr)

Written and Spoken English
- Engl 104, 105 Language in Composition and Reading 8 credits
- Sp 211 Fundamentals of Speech 3 credits

Anthropology
- Anthro 218 Introduction to Cultural Anthropology 3 credits

Foreign Language
- All credits must be in a single language

Total 68 Credits

International Service Program in the College of Home Economics

An emphasis in international service programs is designed to provide students with a background for participation in government or agency programs such as Peace Corps, Voluntary International Service Assignments (VISA), etc., as well as provide an opportunity for young women to become oriented to national and international affairs as part of their responsibility of citizenship in its broadest sense.

Students in home economics with a concentration in international service 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 General Education, Curriculum for the specific program. Interested students in home economics should consult Julia M. Faltinson for further details.

International Relations Major in the College of Sciences and Humanities

Students wishing to major in international relations in the College of Sciences and Humanities must also major in anthropology, economics, foreign languages, history, journalism, political science or sociology. They may then substitute the major in international relations for the minor required of students in the College of Sciences and Humanities. In addition to fulfilling group requirements and the major requirements in the discipline he has chosen, each student majoring in international relations must complete the following program:
A. General Courses in International Relations. Students majoring in anthropology, economics, history, journalism, political science or sociology must select from the following list four disciplines other than their own and must complete at least six credits in each of the four. Foreign language majors must select at least six credits in any four of the following disciplines. Courses offered in completion of this requirement must be chosen from those listed under each discipline.

**Economics**
- 306 Comparative Economic Systems (3 cr)
- 411 Economics of Underdeveloped Nations (3 cr)
- 455 International Economics (3 cr)
- 456 International Finance (3 cr)

**Geography**
- 324 Cultural Geography European and American (3 cr)
- 325 Cultural Geography African, Asian, Australian and Pacific (3 cr)
- 201 World Geography (3 cr)
- 322 Economic Geography (3 cr)

**History**
- 203 Western Civilization (3 cr)
- 477A, 477B, 477C History of U.S. Foreign Policy (3 cr each)

**Journalism**
- 440 International Communication and the Foreign Press (3 cr)
- 545 Mass Communication in Developing Nations (3 cr)

**Political Science**
- 340 Politics of Developing Areas (3 cr)
- 351, 352, 353 World Politics and International Organization (3 cr each)
- 458 American Foreign Policy (3 cr)

**Sociology and Anthropology**
- 321 Comparative Studies of World Cultures (3 cr)
- 424 Ethnology of the Old World (3 cr)
- 425 Intercultural Relations (3 cr)

Total 24 credits

B. Non-Western and Latin American Studies. The student must complete at least six credits in one of the following groups:

**Africa and the Middle East**
- D St 104 The African Continent, People and Cultures (3 cr)
- D St 105 Survey of African History (3 cr)
- D St 106 Africa in World Affairs (3 cr)
- Pol S 445 Politics of the Middle East (3 cr)
- Pol S 446A, 446B Governments of Africa South of the Sahara (3 cr each)

**Asia**
- Hist 340, 341 Introduction to East Asia (3 cr each)
- Hist 443 Modern Japanese History (3 cr)
- Phil 456 Oriental Religious Philosophy (3 cr)
- Pol S 442A Governments of Eastern Asia (3 cr)
- Pol S 442B Governments of India, Pakistan and Southeast Asia (3 cr)
- Pol S 451 Asia in World Affairs (3 cr)

**Latin America**
- Anthro 323 Contemporary Latin American Cultures (3 cr)
- Anthro 325 Native Peoples of Middle and South America (3 cr)
- Hist 350, 351, 352 History of Latin America (3 cr)
- Pol S 443A Latin American Governments (3 cr)
- Pol S 443B Recent Latin American Politics (3 cr)
- Hist 479A, 479B Inter-American Relations (3 cr each)
Russia

Hist 416A, 416B, 416C History of Modern Russia (3 cr each)
Hist 478 U.S.-Soviet Relations (3 cr)
Pol S 444 Government and Politics of the Soviet Union (3 cr)

Total 6 credits

C. Language. The student majoring in International Relations must complete 27 credits in one language. Twenty-one of these should be applied to Group VII of the Sciences and Humanities curriculum requirement.

Total 6 credits

D. International Relations Seminar to be taken during the student's junior or senior year.

Total 3 credits

Overall total 39 credits

JOURNALISM AND MASS COMMUNICATION

James W. Schwartz, M.S., Head of Department

Professors: Rodney T. Fox, M.S.J.; Carl Hamilton, B.S.; Kenneth R. Marvin, M.S.

Associate Professors: Edmund G. Blinn, M.S.; Richard L. Disney, Jr., B.A.; J. K. Hvistendahl, M.A.; K. Robert Kern, Ph.D.; William F. Kunerth, M.S.J.; Jack D. Shelley, B.J.; Donald E. Wells, Ph.D.


Instructors: Robert D. Greenlee, M.S.; Susan Menne, M.A.; Paul Yarbrough, Ph.D.

Undergraduate Study

Students wishing to prepare for careers in professional journalism may enroll as majors in any one of four colleges—Agriculture, Home Economics, Sciences and Humanities, or Engineering. General journalism requirements are listed below while the Index references the specific curricula in agricultural communication, home economics journalism, science journalism and engineering journalism.

Instruction in journalism is offered to all students and adapted as far as possible to their individual needs. Its purpose is two-fold: To serve those professionally interested in journalism and to aid non-majors in their relationships with mass media and to improve their general ability to communicate.

Professional students are offered preparation for editorial and advertising-promotion positions with newspapers, magazines, radio and television; for technical writing positions in a variety of specialized fields, and for public relations and information positions with industry and government. The major in journalism consists of a minimum of 34 credits of course work plus 6 credits of 490J, professional work requirement. Course work includes 101, 201, 202, 203, and at least four 300-level and three 400-level courses in journalism. The requirements of the appropriate college of residence—Agriculture, Engineering, Home Economics, Sciences and Humanities—must also be completed.

Students majoring in science journalism may substitute a second major in international relations for the two minors required in the College of Sciences and Humanities. See International Relations
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 major work for the degree of Master of Science 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 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. 4. 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 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.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 non-majors 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 darkroom techniques. Evaluation of pictures, the picture story, lighting, pictorial composition.

318. LABORATORY IN PHOTOJOURNALISM.
(0-6) Cr. 3. F.S.
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. $10 lab fee.

325. ADVERTISING.
(3-0) Cr. 3. F.W.S.SSI.
Principles of advertising history, social, economic and legal aspects, basic appeals, servicing advertising accounts.

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.W.
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.
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.SSI.
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. 3. F.S.
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.
440. INTERNATIONAL COMMUNICATION AND THE FOREIGN PRESS.
(3-0) Cr. 3. S.
Prerequisite: Junior classification.
Study of world news communication systems encompassing news-gathering agencies, the role of foreign correspondents, and the factors determining the flow of world news. Comparative analysis of mass media systems in developed countries.

462. PRESS FREEDOM, RESPONSIBILITY AND ETHICS.
(3-0) Cr. 3. F.S.S.I.
Prerequisite: Junior classification.
Philosophies on 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. W.
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. S.
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. S.S.I.
Prerequisite: Junior classification.
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 non-major 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)
K Technology

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.
Prerequisite: 512 or permission of instructor.
The process of developing professional communication and persuasion strategies, with emphasis on problem definition, behavioral specification of objectives, situation analysis, strategy formulation and justification through application of communication theories and research results.

526, 527, 528. REPORTING ON SCIENCE AND TECHNOLOGY.
(1-4) Cr. 3 each. Yr.
Prerequisite: 526: Graduate standing or permission of instructor; 527: 526 or equivalent; 528: 527 or permission of instructor.
Writing and editing problems of the communicator who mediates between scholar, scientist and various reading publics. Communication objectives, audience analysis, code selection, treatments, media characteristics.

545. MASS COMMUNICATION IN DEVELOPING NATIONS.
(3-0) Cr. 3. F.
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

690. RESEARCH.

LANDSCAPE ARCHITECTURE

Thomas A. Barton, M.L.A., Head of Department


Associate Professors: William A. Malone, M.S.; Frank W. Osgood, M.C.P.; Margherita Tarr, B.S.


Undergraduate Study

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 characteristics 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.

Graduates are employed by professional landscape architects and by governmental agencies at local, state, and national levels.
Graduate Study

The department offers major work for the degree Master of 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 acceptance 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 either the degree Master of Landscape Architecture or Master of Science; however, a satisfactory reading knowledge of German, French, Russian or Spanish will be required when specifically recommended by the student's advisory committee.

Open to graduate students for minor credit only: 404, 411, 412, 413, 436, 445, 466.

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.S.
Introduction to and experimentation with the graphic media used by the landscape architect and urban planner, including instrument drawing, lettering, dimensioning, and freehand sketching.

113. LANDSCAPE PERCEPTION. (1-6) Cr. 3. 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. F.
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, planning the site, the city and the region, 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. (2-6) Cr. 4. S.
Fundamental theory and principles of design brought out in the solution of simple problems.

231. 232, 233. PLANT MATERIALS. (0-4) Cr. 2 each. Yr.
Prerequisite: 231: Biol. 103; 232: 231; 233: 232. 231: Introduction to study of plant materials as used in landscape architecture. 232: Study of trees, shrubs and vines, with emphasis on their winter characteristics. 233: Trees and shrubs, vines, evergreens and herbaceous material. Field trips and reports.

251. DETAILS OF CONSTRUCTION I. (1-6) Cr. 3. S.
Prerequisite: C.E. 211A.
Theory and laboratory problems in landscape construction, including earthwork, drainage, and utility plans, quantity estimates.

311, 312, 313. LANDSCAPE DESIGN. (0-12) Cr. 4 each. Yr.
Prerequisite: 213. Design of private and public properties based on actual topographies. Drafting, field work, reports, criticism. These courses are coordinated with the Details of Construction series and the Planting Design series for the execution of complex problems.

334. PLANTING DESIGN I. (0-9) Cr. 3. F.
Prerequisite: 233, classification in 311. Arrangement and use of plants in landscape and architectural design, with drafting and field practice.

335. PLANTING DESIGN II. (2-9) Cr. 5. S.
The use of plants in environmental design. Association, selection, and specifications.

341, 342. TRAVEL AND PRACTICE. (Ur.Pl. 341, 342) Cr. R. F.

352. DETAILS OF CONSTRUCTION II. (1-6) Cr. 3. W.
Prerequisite: 251. Materials and techniques of landscape construction. Preparation of contract drawings.

404. OUTDOOR RECREATION IN THE UNITED STATES. (3-0) Cr. 3. F.
Survey of historical aspects, current problems, and future trends; influence of natural resources. Introduction to planning and selection of sites for recreation use.

411, 412, 413. ADVANCED LANDSCAPE DESIGN. (0-9) Cr. 3 each. Yr.
Prerequisite: 313. Design of public, semi-public and large private properties.

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.
410 Courses and Programs

436. ADVANCED PLANTING DESIGN.
(0-9) Cr. 3. W.
Prerequisite: 335.
Advanced study of planting design

445. 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.

COURSES PRIMARILY FOR GRADUATE STUDENTS, major or minor, open to qualified undergraduates

500. SEMINAR.
(1-0) Cr. 1. W.S.

514, 515, 516. LANDSCAPE ARCHITECTURE
- DESIGN.
(0-9) Cr. 3 each. F.W.S.
Prerequisite: 413.
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.

550. SPECIAL TOPICS.
Cr. 2 to 5 each time elected. F.W.S.
Prerequisite: Permission of department head and instructor.
A. Landscape Design.
B. Planting Design.
C. Details of Construction.

URBAN PLANNING

Administered by the Department of Landscape Architecture.

Undergraduate Study

The urban planner is concerned with the economic, social and physical 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, 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.

A student expecting to do major work in town and regional planning should have included in his previous studies: 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 Stat. 201 and Com. S. 214, or their equivalents, he will be required
to take these 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.

Satisfactory completion of the core requirements and the acceptance of a thesis is required for the M.S. degree. The core requirements are:

<table>
<thead>
<tr>
<th>Planning Theory</th>
<th>9 credits (including Ur.Pl. 561)</th>
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<tbody>
<tr>
<td>Descriptive</td>
<td>8 credits (including Ur.Pl. 562)</td>
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<tr>
<td>Normative</td>
<td>6 credits (including Ur.Pl. 571)</td>
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<tr>
<td>Planning Techniques</td>
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<tr>
<td>Plan Components</td>
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<td>Transportation</td>
<td>7 credits</td>
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<tr>
<td>Housing</td>
<td>6 credits</td>
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<td>Planning Law</td>
<td>3 credits</td>
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<tr>
<td>Planning Studio</td>
<td>12 credits (including 3 credits</td>
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<td>each of Ur.Pl. 530A and 530B)</td>
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<tr>
<td>Seminar</td>
<td>3 credits (Ur.Pl. 510)</td>
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<tr>
<td>Statistics</td>
<td>4 credits (Stat. 401)</td>
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The specific numbered courses must be taken within this graduate program. Remaining core requirements must be approved by the student's major professor.

The following courses are open for major graduate credit to graduate students in town and regional planning: Arch. 590, 681, 682, 683; C.E. 553, 556, 690; Econ. 510, 556, 564, 565, 566, 576, 680; F.E. 521; Pol.S. 512, 530, 532A, 532B; L.A. 550A, 600; Soc. 570, 575, 590, 664, 695, 699B; Ur.Pl. 510, 530A, 530B, 550D, 550F, 550F, 550G, 550H, 550I, 550J, 561, 571, 620.

Open to graduate students for minor credit only: 361, 372, 373, 383, 431, 432, 433, 456, 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 PRIMARILY FOR UNDERGRADUATE STUDENTS

110A. ORIENTATION IN URBAN PLANNING. (1-0) Cr. R. F.
Survey of urban planning and allied fields

112. GRAPHIC COMMUNICATION. (L.A. 112) See Landscape Architecture.

253. SURVEY OF URBAN PHYSICAL PLANNING. (3-0) Cr. 3. W.S.
An historical survey of the nature and problems of urban areas and the goals, procedures, and results of physical planning

341, 342. TRAVEL AND PRACTICE. (L.A. 341, 342) See Landscape Architecture.

361. URBAN PROBLEMS AND PLANNING GOALS. (3-0) Cr. 3. F.
Prerequisite: 253.
Major urban physical problems and their relations to social, economic, and technological problems. Planning goals—both practical and theoretical—and their interrelations and consequences

372, 373. PLANNING ANALYSIS AND TECHNIQUES. (3-0) Cr. 3 each. W.S.
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

383. THEORY OF THE PLANNING PROCESS. (3-0) Cr. 3. W.
Prerequisite: 253.
The nature of physical planning and its relation 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.

431. URBAN DEVELOPMENT PLANNING. (0-12) Cr. 4. F.S.
Prerequisite: 361, 372, 373, Econ. 461, C.E. 350.
Preparation of the comprehensive plan, including alternatives. Preparation of selected effectuating devices for one or more of these alternative plans

432. URBAN DEVELOPMENT PROGRAMMING. (0-12) Cr. 4. W.
Prerequisite: 431.
The programming of plans through time, by such means as community renewal programming and urban renewal projects, capital improvement programming and capital budgets.
433. COLLABORATIVE STUDIO IN REGIONAL PHYSICAL PLANNING. (0-9) Cr. 3 S.  
Prerequisite: Senior classification in urban planning, or senior standing in other curricula and permission of instructor and course committee. Collaborative preparation of a comprehensive physical plan for a metropolitan or resource region. Intended primarily for those whose career objective includes full or part time practice in regional planning. Supervised by a course committee composed of faculty representatives from various allied departments and chaired by the instructor.

456. SPECIAL PROBLEMS. Cr. 2 to 4. F.W.S.

COURSES PRIMARILY FOR GRADUATE STUDENTS, major or minor, open to qualified undergraduates

510. SEMINAR. (1-0) Cr. 1. F.S.

530A. ADVANCED PHYSICAL PLANNING. (2-3) Cr. 3 F.  
Prerequisite: 432 and 561, or graduate classification in town and regional planning. Research methods for the discovery of new knowledge in town and regional form and planning. Review of current literature.

530B. ADVANCED PHYSICAL PLANNING. (0-9) Cr. 3 W.S.  
Prerequisite: 432 and 561, or graduate classification in town and regional planning. Practice in the advanced level application of existing knowledge to planning projects, with emphasis on the planning of new towns and urban regions.

550. SPECIAL TOPICS. Cr. 2 to 5 each time elected. F.W.S.  
Prerequisite: Permission of department head and instructor.

D. Urban Development Planning and Programming
E. Urban Renewal
F. Regional and State Planning and Programming

561. 562. THEORY OF PHYSICAL PLANNING. (3-0) Cr. 3 each. F.W.  
Prerequisite: 361 and 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 PHYSICAL PLANNING. (3-0) Cr. 3 F.  
Prerequisite: 372 or graduate classification in town and regional planning. Advanced qualitative and quantitative techniques in the preparation and programming of physical plans. Emphasis on new techniques derived from advanced planning theory.

COURSES FOR GRADUATE STUDENTS, major or minor

620. RESEARCH.

LIBRARY

Warren B. Kuhn, M.L.S., Head of Department

Professor: Robert W. Orr, M.S.

Associate Professors: Matynie H. Easton, B.A.; John E. Galejs, M.A.L.S.; John C. McNeely, A.M.I.S.; Margaret H. Orr, B.L.S.; Fred M. Peterson, M.A.; Elizabeth A. Windsor, M.S.

Assistant Professors Mildred E. McHone, B.S.; Eleanor J. McKee, M.A.L.S.; Olive B. Nordskog, B.S.; E. Marjorie Smith, M.A.


Prerequisite: Permission of department head and instructor.

H. Honors Program
Investigation of an approved topic commensurate with student's interest and ability.

492. PLANNING LAW AND ADMINISTRATION. (3-0) Cr. 3 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.
Undergraduate Study

Courses are designed to increase facility in the independent use of libraries and books. Lib. 101 is required without credit of all freshmen and transfer students in the College of Home Economics.

Lib. 102 is required without credit of all freshmen and transfer students in the College of Engineering.

Lib. 205 is required with one credit of all freshmen and transfer students in the College of Sciences and Humanities.

Lib. 206 is required with one credit of all freshmen and transfer students in the College of Agriculture.

Graduate Study

The library offers facilities for bibliographic research in the scientific and technical literature of the departments giving graduate instruction. The course "Bibliographic Research" (620, 630, 640) may be taken for either major or minor credit in any department.

COURSES FOR GRADUATE STUDENTS, major or minor

620, 630, 640. BIBLIOGRAPHIC RESEARCH.

(1-0) Cr. 1 F.W.S.S.

620 For students in the physical sciences and engineering.
630 For students in the biological and life sciences.
640 For students in the social sciences and humanities.

Lectures and practice on location of printed and manuscript materials and preparation of bibliographies on technical and scientific subjects.

MATHEMATICS

Wilfred E. Barnes, Ph.D., Head of Department


Undergraduate Study

The undergraduate curriculum in sciences and humanities, major 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 are:

1. 18 credits at the 300-level or above, to be specified by the Department of Mathematics.
2. At least 12 additional credits at the 300-level or above, to be elected by the student in a manner consistent with his interests and objectives.

Credits earned in the courses 101, 101B, 101C, 103, 104, 105, 190, 191, and 192 can not be counted for credit toward graduation by mathematics majors.

Graduate Study

The department offers major work for the degrees Master of Science and Doctor of Philosophy 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 in algebra, real and complex analysis, and topology.

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. Non-credit course. 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. Non-credit course. 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

*101. ALGEBRA AND TRIGONOMETRY. 
(5-0) Cr. 5. F.W.S.SS.
Prerequisite: One and one-half units of high school algebra.
Sets, inequalities, polynomial equations and systems of equations, analytical trigonometry, complex number field.

*101B. ALGEBRA AND TRIGONOMETRY. 
(3-0) Cr. 3. SS.
Prerequisite: One unit of high school algebra. Same material as first half of 101, plus remedial and supplementary material in algebra

*101C. ALGEBRA AND TRIGONOMETRY. 
(3-0) Cr. 2. SS.
Prerequisite: 101B.
Same material as second half of 101

*Math. 101, 101B, and 101C will be non-credit courses after August 1971
103. PRECALCULUS MATHEMATICS.  
(5-0) Cr. 5. F.W.S.S.  
Prerequisites: Two units of high school algebra, one unit of geometry, and one-half unit of trigonometry, or Math. 101. For students who intend to take the calculus. Inequalities, functions and their graphs, including rational, circular, exponential and logarithmic functions.

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 non-technical content.

110, 111, 112. ANALYTIC GEOMETRY AND CALCULUS I, II, III.  
(5-0) Cr. 5 each. F.W.S.S.  
Prerequisites: 110 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.; 162: S.  
Prerequisite: 103 or 104. 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 numbers, system, functions, and important theorems from calculus. Emphasis placed on developing mathematical maturity. Primarily for mathematics majors. Offered on pass-fail basis only.

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.

304, 305, 306. DISCRETE AND CONTINUOUS MATHEMATICAL MODELS.  
(3-0) Cr. 3 each. 304: F.W.; 305: W.S.; 306: F.S.  

321, 322. INTRODUCTION TO APPLIED MATHEMATICS I, II.  
(3-0) Cr. 3 each. F.W.S.S.  

330. TOPICS IN EUCLIDEAN GEOMETRY.  
(3-0) Cr. 3. S.S.S.  
Prerequisite: 301. Concepts and properties of Euclidean geometric systems.

331, 332, 333. TOPOLOGY.  
(3-0) Cr. 3 each. Yr.  

341, 342, 343. INTRODUCTION TO THEORY OF PROBABILITY AND STATISTICS.  
(Stat. 341, 342, 343) See Statistics.

404. THEORY OF MATRICES.  
(3-0) Cr. 3. F.S.S.S.  
Prerequisite: 112. Matrices and quadratic forms in the real and complex number fields.

406. INTRODUCTION TO NUMERICAL TECHNIQUES FOR COMPUTERS.  
(Com.S. 406) (3-2) Cr. 3. F.W.S.  

407, 408. NUMERICAL ANALYSIS I, II.  
(Com.S. 407, 408) (3-0) Cr. 3 each. 407: W.; 408: S.  

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. 409, 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: 302. 331 or concurrent enrollment in 331 is desirable. 414: Normed linear spaces, completeness, limits, iteration of limits, differentiation of vector functions. 415: Integration on the line, multiple integrals, Green's Theorem. 416: Topos to be
selected from 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 Com.S. 223 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.

COURSES PRIMARILY FOR GRADUATE STUDENTS, major or minor, open to qualified undergraduates

504, 505, 506. ABSTRACT ALGEBRA.
(3-0) Cr. 3 each. Yr.
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: 404.
Numerical methods involved in the solution of linear systems, matrix inversion, eigenvalue problems (symmetric and non-symmetric), completion method, ill-conditioned matrices, linear inequalities. Examples using University computers.

511. 512. FUNCTIONS OF A SINGLE COMPLEX VARIABLE.
(3-0) Cr. 3 each. 511: F.S.S.; 512: W.S.S.
Prerequisite: 410 or 415.
Topological concepts for extended complex plane, analytic functions, conformal mappings, integration, power series, Laurent series, Cauchy residue theorem, evaluation of real integrals, harmonic functions, analytic continuation.

514, 515, 516. REAL ANALYSIS.
(3-0) Cr. 3 each. 514: F.S.S.; 515: W.S.S.; 516: S.
Prerequisite: 415.
Basic concepts of topological spaces, function spaces, measure and integration.

521, 522, 523. APPLIED MATHEMATICS.
(3-0) Cr. 3 each. Yr.
Prerequisite: 302, 411.

Properties of the integers. Diophantine equations, prime number distribution and representation problems.

490. HISTORY OF MATHEMATICS.
(3-0) Cr. 3. F.
Prerequisite: 112 and junior classification.
Sources of mathematical principles, growth of mathematical knowledge, contributions of outstanding mathematicians.

497. TEACHING OF SECONDARY SCHOOL MATHEMATICS.
(3-0) Cr. 3. W.
Prerequisite: 22 credits in college mathematics.
Organization of subject matter, methods of presenting particular topics, evaluation of results.

499. SPECIAL PROBLEMS.
Cr. 1 to 3 each time elected. F.W.S.S.
Prerequisite: 202.
H Honors Program.

524, 525. THEORY OF AUTOMATA.
(Com.S. 524, 525) (3-0) Cr. 3 each. 524: W.; 525: S.
Prerequisite: 421.
Various notions, 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. INTEGRAL EQUATIONS.
(3-0) Cr. 3 each. Alt. W.S. Offered 1971.
Prerequisite: 526: 411 or 415; 527: 526.
526 Linear equations with continuous kernels. 527 Introduction to Hilbert space, elementary spectral analysis.

528, 529. SPECIAL FUNCTIONS.
(3-0) Cr. 3 each. 528: F.; 529: W.
Prerequisite: 511.
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. INTRODUCTION TO FUNCTIONAL ANALYSIS.
(3-0) Cr. 3 each. 531: W.; 532: S.
Prerequisite: Permission of Instructor.

534, 535, 536. TOPOLOGY.
(3-0) Cr. 3 each. Yr.
Prerequisite: 302, 333.
Foundations of point set theory. Introduction to homotopy and homology.

541, 542, 543. THEORY OF PROBABILITY AND STATISTICS.
(Stat. 541, 542, 543) See Statistics.

554, 555. PROBABILITY.
(Stat. 554, 555) (3-0) Cr. 3 each. 554: W.; 555: S.
Prerequisite: 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. ORDINARY DIFFERENTIAL EQUATIONS.
(3-0) Cr. 3 each. 557: W.; 558: S.
Prerequisite: 213 and 410 or 415.
The initial value problem, existence and uniqueness theorems, linear systems, asymptotic behavior of solutions, two-dimensional systems.

562, 563. DIFFERENTIAL GEOMETRY.
(3-0) Cr. 3 each. Alt. Yrs. Offered 1970.
Prerequisite: Permission of instructor.
Differentiable manifolds, local and global properties of curves and surfaces in Euclidean spaces.

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 ultralimits, nonstandard analysis.

574, 575, 576. TOPICS IN ABSTRACT ALGEBRA.
(3-0) Cr. 3 each. Yr.
Prerequisite: 506.
Topics selected from homological algebra, commutative algebra, and group theory.

581, 582, 583. AXIOMATIC SET THEORY.
(3-0) Cr. 3 each. Yr.
Prerequisite: 504 or 514 or 531.
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.

599. SPECIAL TOPICS.
F.W.S.SS.

COURSES FOR GRADUATE STUDENTS, major or minor
(Offered on demand)

601. SPECIAL TOPICS.
Cr. 3 each time elected.
Prerequisite: Permission of instructor.
A. Calculus of Variations.
B. Functional Analysis.
C. Measure Theory.
D. Approximation Theory.

604, 605. ADVANCED TOPICS IN ABSTRACT ALGEBRA.
(3-0) Cr. 3 each. 604: W.; 605: S.
Prerequisite: 506.
Associative algebras and rings, local algebras, homological algebra.

607. ADVANCED TOPICS IN NUMERICAL ANALYSIS.
(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, 612, 613. ADVANCED TOPICS IN THE THEORY OF FUNCTIONS OF A SINGLE COMPLEX VARIABLE.
(3-0) Cr. 3 each. Yr.
Prerequisite: 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, 616, 617. ADVANCED TOPICS IN FOUNDATIONS OF MATHEMATICS.
(3-0) Cr. 3 each. Yr.
Topics selected from mathematical logic, recursive function theory, model theory and set theory.

621, 622, 623. ADVANCED TOPICS IN PARTIAL DIFFERENTIAL EQUATIONS.
(3-0) Cr. 3 each. Yr.
Prerequisite: 511, 521.
Maximum principles, pointwise bounds, conservation equations, distributions, Hilbert space.

634, 635, 636. ADVANCED TOPICS IN TOPOLOGY.
(3-0) Cr. 3 each. Yr.
Prerequisite: 536.
Topics selected from dimension theory, topology of manifolds, homotopy and homology theory, structure of continua.

642. PROBABILITY AND DISTRIBUTION THEORY.
(Stat. 642) See Statistics.

657, 658, 659. ADVANCED TOPICS IN ORDINARY DIFFERENTIAL EQUATIONS.
(3-0) Cr. 3 each. Yr.
Prerequisite: 515.
Existence, uniqueness, stability and asymptotic behavior of solutions of systems of ordinary differential equations; perturbation theory; control theory.

699. RESEARCH.
MECHANICAL ENGINEERING

Henry M. Black, S.M., Head of Department

Professors: Robert C. Fellinger, M.S.; Charles R. Mischke, Ph.D.; George K. Serovy, Ph.D.

Associate Professors: William J. Cook, Ph.D.; Ray Fisher, B.S.; Marvin Gould, B.S.; Alexander Henkin, Ph.D.; Bruce L. Johnson, Ph.D.; George H. Junkhan, Ph.D.; Patrick Kavanagh, Ph.D.; Kermit Myers, M.S.; Leo C. Peters, Ph.D.


Instructor: Donald E. Wandling, 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 major work for the degrees Master of Science and Master of Engineering 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 divided major with departments offering work in related fields for this degree.

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 foreign language requirement for the degree Master of Science may be waived upon recommendation of the department head.

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. F.S.  
Prerequisite: Met. 230 and E.M. 324 or 325.  
Plastic deformation, fracture, fatigue, creep and wear of metals. Mechanical and metallurgical aspects.

251, 252. INTRODUCTION TO MECHANICAL ENGINEERING I, II.  
(0-0) Cr. 4. F.P.  
Prerequisite: Math. 111, Phys. 222, E.Gr. 162.  
Application of the basic principles of structure and properties of metals. Ferrous and nonferrous systems.

251, 252, 322, 321, 323, 251, 252. INTRODUCTION TO MECHANICAL ENGINEERING I, II.  
(0-0) Cr. 4. F.P.  
Prerequisite: Math. 111, Phys. 222, E.Gr. 162.  
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, 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. S.F.  
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. 230, 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. 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.  
(1-0) 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 317, E.E. 442.  

343. MECHANICAL ENGINEERING LABORATORY.  
(6-6) Cr. 2. F.W.  
Prerequisite: 341, credit or classification in 424 and 440.  
Laboratory investigation of selected experiments in thermodynamics, fluid and machine dynamics. Nozzles, fluid meters, calorimetry, psychrometry, boundary layer, fluid flow and viscosity.

344. THERMODYNAMICS.  
(5-0) Cr. 5. F.W.S.  
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: B. Cn. 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.  
(2-8) 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, E.E. 442.  
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: 318, 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.S.SII; 422: (3-0) Cr. 3. W.S.SSI.
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; 426: (4-0) Cr. 4.
F.W.S.SII.
Prerequisite: E.M. 345, Math. 321, credit or classification in 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.
(3-0) Cr. 4. S.
Prerequisite: 445.
Design and layout of a high-speed internal combustion engine of carburetion or diesel type.

COURSES PRIMARILY FOR GRADUATE STUDENTS, major or minor, open to qualified undergraduates

501. ENGINEERING MEASUREMENT I.
(3-0) Cr. 3. F.
Prerequisite: Permission of instructor.
Techniques for the analysis and interpretation of experimental data. Treatment of errors, planning of experimental programs.

502. ENGINEERING MEASUREMENT II.
(3-0) Cr. 3. W.
Prerequisite: 501.

440. FUELS AND COMBUSTION.
(4-0) Cr. 4. F.W.SSI.
Prerequisite: 322, credit or classification in Chem. 381.

442. HEAT POWER LABORATORY.
(0-6) Cr. 2. W.
Prerequisite: 343 or 462, 425, 324 or 440.
Determination of the performance characteristics of boilers, turbines, engines, refrigeration and air conditioning equipment using standard test code procedures.

444. STEAM POWER PLANTS.
(3-0) Cr. 3. W.S.
Prerequisite: 425, 324 or 440.
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 or 440.

446. 447. ARCHITECTURAL TECHNOLOGIES II.
Arch. 446, 447. (See Architecture.)

448. STEAM POWER PLANT DESIGN.
(2-6) Cr. 4. S.
Prerequisite: 444.
Principle 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 S.W.
Prerequisite: 252, 461.
ASME Power Test Codes and ASTM Standard Test Procedures applied to selected areas of measurement; use of analogies and similitude in engineering experimentation, advanced engineering measurements, presentation of formal reports.

487. SPECIAL PROBLEMS.
Cr. 3 to 5. F.W.S.
Prerequisite: Senior classification.
Investigation of topic holding special interest to student. Comprehensive report required. Election of course and topic must be approved by department head.

Instrumentation and auxiliary equipment for the measurement of experimental quantities. Application of mechanical, electrical and optical systems in obtaining accurate and reliable results.

513. LUBRICATION AND FRICTION.
(4-0) Cr. 4. W.
Prerequisite: 317, 424.
Theories of lubrication and friction and their application to design.
515. ADVANCED DESIGN.  
(4-0) Cr. 4. W.  
Prerequisite: E.M. 514.  
Experimental, empirical and rational methods of analysis and synthesis in the solution of advanced design problems.

516. ADVANCED KINEMATICS OF MECHANISMS.  
(3-0) Cr. 3. F.  
Prerequisite: 318.  
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, polarode 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.

523. THERMODYNAMICS OF COMPRESSIBLE FLOW I.  
(4-0) Cr. 4. W.  
Prerequisite: 321 or 344, 424 or E.M. 378.  

524. 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. S. Offered 1970.  
Prerequisite: 440.  

541, 542, 543. ADVANCED AERODYNAMICS.  
(Aer. E. 541, 542, 543) See Aerospace Engineering.

544. PRINCIPLES OF TURBOMACHINERY.  
(4-0) Cr. 4. S.  
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.  
(Aer. E. 545) (3-0) Cr. 3. F.  
Prerequisite: 523, 544 or Aer. 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.  
(Aer. 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.

571, 572, 573. ADVANCED FLUID MECHANICS.  

587. SPECIAL TOPICS.  
Cr. 2 to 8. F.W.S.  
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 1970; 622: Offered 1971.  
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.

623, 624. MAGNETOFLUID MECHANICS AND PLASMA DYNAMICS.  
(Aer. E. 623, 624) See Aerospace Engineering.

625. ADVANCED HEAT TRANSFER I.  
(3-0) Cr. 3. Alt. F. Offered 1970.  
Prerequisite: 426 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 1971.  
Prerequisite: 426 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.
METALLURGY

John F. Smith, 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.; John D. Verhoeven, Ph.D.

Assistant Professors: Donald M. Bailey, M.S.; Francis X. Kayser, Sc.D.; John W. Patterson, Ph.D.; Rohit K. Trivedi, 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.

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.

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. 103, 110, 111, 112, 213 plus one additional course in mathematics, statistics or computer science; Phys. 221, 222, 223, 301, 302, 303; Chem. 101, 102, 103, 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.
Graduate Study

Advanced work leading to the degrees Master of Science and Doctor of Philosophy in metallurgy is provided, and minor work is offered 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 must obtain a satisfactory score on an Educational Testing Service examination in either French, German or Russian and subsequently demonstrate the ability to translate scientific literature in one of these languages.

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.S.
Introduction to the metallurgical profession Career opportunities and requirements

201. EXTRACTIVE METALLURGY. (3-0) Cr. 3. W.
Prerequisite: Chem. 103.
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, Chem. 103.
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. 103.

231. METALLURGY FOR ENGINEERS. (3-0) Cr. 3. P.W.
Prerequisite: Chem. 102, 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 distribution theory, deformation of grains 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

305, 306, 307. PHYSICAL METALLURGY LABORATORY. (0-6) 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) (3-2) Cr. 4. F.W.S.S.SI.
Prerequisite: 235, E.M. 326.
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. (M.E. 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

360. METALLURGICAL THERMOCHEMISTRY. (3-0) Cr. 3. W.
Prerequisite: Chem. 321.
Equilibria in homogeneous and heterogeneous systems. Phase rule; unary and binary systems; phase boundaries. Applications to calculations of adiabatic reaction temperatures, metal-slag and metal-salt equilibria; spinodal decomposition; ionic processes in solids and liquids
361. CHEMICAL METALLURGY. (3-0) Cr. 3. S.
Prerequisite: Math. 213, Phys. 222, Chem. 103.
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. ENGINEERING METALLURGY. (3-0) Cr. 3 each. F.W.
Prerequisite: 303. Elasticity and plasticity, applications to metalurgical 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.

450. SPECIAL PROBLEMS. Cr. arr. F.W. S.S.S.S.SI.
Prerequisite: Junior classification, approval of adviser. Investigation of individual research problems or special topics.

COURSES PRIMARILY FOR GRADUATE STUDENTS, major or minor, open to qualified undergraduates

510, 511. ADVANCED PHYSICAL METALLURGY. (3-0) Cr. 3 each. W.S.
Prerequisite: 303 or 410. Point defects, nucleation and growth, solid state reactions, diffusionless transformations. Applications of principles to processes occurring in metals.

512. INTRODUCTORY METAL THEORY. (3-0) Cr. 3. F.
Prerequisite: Credit or classification in Math. 409. Free electron theory and band theory. Brillouin zones and Fermi surfaces, electronic conductivity and scattering processes, magnetic behavior, electronic and lattice heat capacities, cohesion and elastic constants.

532. STRUCTURE AND PROPERTIES OF STEEL. (3-0) Cr. 3. S.
Prerequisite: 303, 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. Theoretical analysis of whole, partial, and twinning dislocations, relations to stacking fault energy. Interactions of dislocations with dislocations and point imperfections. Low and high angle boundaries. Formation and multiplication of dislocations. Dislocations in crystal structures and crystal growth. Elementary strengthening mechanisms.

541. APPLICATIONS OF DISLOCATION THEORY. (3-0) Cr. 3. S.
Prerequisite: 540. Application of Thompson tetrahedron to dislocation interactions during plastic flow of crystals. Dislocation theories of work hardening in single and polycrystals as related to strain, strain rate, temperature and structure. Mechancisms of fracture, fatigue and creep. Effect of dislocations on internal friction, preferred orientation, magnetic behavior and superconductivity.

555. X-RAY DIFFRACTION AND METALLOGRAPHY. (3-0) Cr. 3. W.
Prerequisite: 301 or 410. Introduction to the theory of x-ray and neutron diffraction, symmetry operations, space groups, and reciprocal lattice. Interpretation of Laue and powder patterns and their application to precise lattice parameters, determination of simple crystal structures, phases, orientation texture, grain size and strain, and to the study of magnetic phenomena, alloy theory, ordering and other physical properties.

557. X-RAY DIFFRACTION AND METALLOGRAPHY LABORATORY. (0-6) Cr. 2. S.
Prerequisite: 555. Experiments in x-ray diffraction and metallography which deal with the operation of x-ray equipment, preparation of samples, taking and analyzing powder patterns, orientation of single crystals by Laue method and determination of textures.

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. 563. METALLURGICAL THERMODYNAMICS. (3-0) Cr. 3 each. 562: F; 563: W.

571. CORROSION AND OXIDATION. (3-0) Cr. 3. F.
Prerequisite: 360 or Chem. 323. A study of the origin, development, and current applicability of theories of corrosion and oxidation of metals.

594. SPECIAL TOPICS IN METALLURGY. Cr. arr. Offered on request.
Prerequisite: Permission of instructor. Topics of current interest in metallurgy.
Music 425

COURSES FOR GRADUATE STUDENTS, major or minor

610, 611. ALLOY THEORY.
(3-0) Cr. 3 each. Alt. F. 610 offered 1970; 611 offered 1969.
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 DEFECTS IN CRYSTALS.
(3-0) Cr. 3. Alt. F. Offered 1970.
Prerequisite: 541.
Quantitative application of kinematic and dynamic theories of electron diffraction contrast to the study of defect substructures such as various dislocation, stacking fault and magnetic domain configurations as well as precipitation, order-disorder, and recrystallization phenomena Moire effects Other techniques for observation of imperfections Emphasis on metals and alloys

655. X-RAY SCATTERING FROM CRYSTALS.
(3-0) Cr. 3 each time taken. Alt. S. Offered 1971.
Prerequisite: Math. 322, 409.
Absorption, dispersion, polarization, refraction and scattering of x-rays. Application in studies of metals. Selected topics, including temperature diffuse scattering, short- and long-range order, faulting in cold-worked metals, extinction effects, dynamical theory of diffraction.

661. KINETICS OF METALLURGICAL REACTIONS.
(2-0) Cr. 2 each time taken. Offered on request.
Prerequisite: 563.
Nucleation and growth, phase transformations and precipitation reactions, creep, diffusion in ionic solids and fused salts.

662. ADVANCED METALLURGICAL THERMODYNAMICS.
(2-0) Cr. 2 each time taken. Offered on request.
Prerequisite: 563.
Thermodynamics of irreversible processes, current research on the application of thermodynamics to physical metallurgy

665. DIFFUSION IN SOLIDS.
(3-0) Cr. 3. Alt. S. Offered 1971.
Prerequisite: 511.

691. METALLURGY SEMINAR.
Cr. arr. F.W.S.SSI.SSII.

695. RESEARCH.

MUSIC

N. Laurence Burkhalter, Ph.D., Head of Department

Professor: Alvin R. Edgar, D. Music
Assistant Professors: Carl O. Bleyle, M.M.; Rollie Blondeau, M.M.; Acton Ostling Jr., M.M.; Eugene Pridonoff, M.M.; Frantisek Smetana; Arthur Swift, M.M.; Gary White, 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, the department of 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, therefore, 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 study to students who wish to concentrate on music as an end in itself or in preparation for teaching, graduate study or other work of a professional nature.

For undergraduate curriculum in sciences and humanities, major in music, leading to the degree Bachelor of Science, see College of Sciences and Humanities, Curricula.
Students majoring in music will normally complete the following courses: 100, 104, 119, 201, 202, 203, 219, 304, 305, 306, 319, 355, 356, 357, 361, 419, and four to six credits from the following: 371, 373, 375, 376, 377, 380, 382, and 490D. The following may be taken on an elective basis. 362, 367, 368, 369, 490A, 490B, 490C, 490H.

Students majoring in music will be required to take private instruction in at least one area of performance every quarter for four years, the amount of credit to be determined by the department. In addition, all students are expected to participate in performing ensembles each quarter. (Allowance will be made for those student-teaching.)

All music majors not enrolled in piano as their principal performance area (secondary piano students) are required to participate in piano proficiency laboratories each successive quarter until such time as they can successfully pass the piano proficiency examination.

In addition to their weekly lessons, students enrolled in 119 and 219 will be required to attend occasional group lessons, performance classes, or seminars to be arranged by instructor and students. Students enrolled in 319 and 419 will be required to attend a laboratory seminar one hour a week to be arranged by students and instructors. The laboratory seminar will consist of integrated studies in applied music including group lessons, pedagogy, literature, and lectures.

Music students whose chief professional interest lies in research, performance or composition are encouraged to minor in foreign languages, history, literature or philosophy. Students wishing to teach music will elect courses leading to certification as described under College of Education. Music courses required for certification are 366 and 466.

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 acceptable 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 on an appointment basis during summer orientation or during the week preceding the opening of classes for any quarter, or during the annual Talent Evaluation Day. 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.

Graduation Proficiency. To be recommended for graduation with a major in music, students should demonstrate 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 solo recital during the junior or senior year.

COURSES PRIMARILY FOR UNDERGRADUATE STUDENTS

99. IOWA STATE UNIVERSITY FESTIVAL CHORUS.
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.

104. INTRODUCTION TO LISTENING.
(2-3) Cr. 3. F.
Prerequisite: Permission of instructor.
Introduction to the art of active listening, emphasis on form, style, and texture of music from various periods.

111, 112, 113. BANDS.
(0-2) Cr. 1 each. Yr.
Open to all students who qualify. Concerts and annual tour in addition to the playing for convocations and athletic events.

119, 219, 319, 419. APPLIED MUSIC.
(0-1 or 1-1) Cr. 1-2. F.W.S. SSI.
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
H. Percussion
121, 122. OPERA STUDIO. Cr. 1 each time taken. F.W. Prerequisite: Permission of instructor. Interpretation and coaching of selected opera scenes and chamber operas, including informal and public presentations.

129. 229, 329. CLASS STUDY IN APPLIED MUSIC. (1-0) Cr. R.F.W.S. Prerequisite: Permission of department head. Class study in instrument or voice. See Music 119, etc. for letter designation for various instruments.

*131. 132. FRESHMAN CHORUS. (0-3) Cr. 1 each. F.W. Open to all freshmen by audition. Designed primarily to develop voice techniques, basic musicianship. Rehearsals three times a week plus Festival Chorus.

133. BASICS VOICE TECHNIQUES. (0-3) Cr. 1.S. Techniques of vocal production: respiration, phonation, resonance, articulation, literature, language pronunciation, and performance.

*141, 142, 143. MEN'S GLEE CLUB. (0-2) Cr. 1 each time taken. Yr. Open to all students by audition. Rehearsals twice weekly plus Festival Chorus, campus concerts, and occasional tours.

*151, 152, 153. ORATORIO CHORUS. (0-3) Cr. 1 each time taken. Yr. Open to all students by audition. Rehearsals three times a week plus Festival Chorus. Concerts with ISU Symphony Orchestra.

154. MUSIC APPRECIATION. (2-1) Cr. 2. F.W.S. Designed to acquaint students with form and meaning of good music. Lectures demonstrated by musical selections.

*161, 162, 163. IOWA STATE SINGERS. (0-5) Cr. 1 each time taken. Yr. Open to all students by audition. Rehearsals five times a week plus Festival Chorus. Campus concerts and annual spring tour.

*171, 172, 173. CHAMBER SINGERS. (0-2) Cr. 1 each time taken. Yr. Open to all students by audition. A select group capable of advanced study performing madrigals through modern music suitable to small ensemble. Several appearances annually.

*175. SUMMER CHORUS. (0-2) Cr. 1 each time taken. SSI. Open to students, staff and community.

*181, 182, 183. ORCHESTRAS. (1-0) Cr. 1 each. Yr. Open to all students who qualify. Concerts presented each quarter; annual tour fall quarter.


304. 305, 306. ADVANCED MATERIALS OF MUSIC. (3-2) Cr. 4. F.W.S. Prerequisite: 203. Should be taken in sequence. Materials of 19th and 20th century music, musical form, orchestration, and counterpoint. Application of these techniques and concepts in analysis and creative work.

310. VOCAL PEDAGOGY. (3-0) Cr. 3. S. Prerequisite: 3 years of voice study. Supervised experience in teaching beginning voice students.

321. 322, 323. ADVANCED ENSEMBLE. (3-0) Cr. 1 each. Yr. Prerequisite: Permission of director and department head. Open to a limited number of undergraduate and graduate students. Advanced proficiency and performing ability required. Designed to give the advanced student opportunity to perform in ensembles which demand a high degree of proficiency.

A. Piano
B. Strings
C. Woodwinds
D. Brass
E. Musica Antiqua

355, 356, 357. HISTORY OF MUSIC. (3-0) Cr. 3 each. Yr. Prerequisite: 100 and either 104 or 154. Should be taken in sequence. Primarily a history of the stylistic development of music. 355: Middle Ages through Renaissance. 356: Baroque and Classical eras. 357: Romantic through Contemporary music.

361. CONDUCTING I. (2-0) Cr. 2. F. Prerequisite: 203. Introduction to conducting. Beat patterns, use of baton, score reading.

362. CONDUCTING II. (2-0) Cr. 2. W. Prerequisite: 361. Section A, Choral Techniques. Section B, Instrumental Techniques. Score readings, repertoire.

364. CREATIVE ACTIVITIES IN MUSIC. (3-2) Cr. 3. F.S. Practical acquaintance with instruments and music for creative learning in music. Emphasis on working with small children, but not limited to this age group. Includes practical observation.

365. MUSIC IN THE ELEMENTARY SCHOOLS. (3-0) Cr. 3. F.W.S.SSI. Basic techniques and material for teaching school music, with emphasis on elementary grades.

366. MUSIC IN GENERAL EDUCATION. (3-0) Cr. 3. S. Objectives, curriculum, methods, and instructional materials appropriate for teaching general music in elementary and secondary schools.

367. PRACTICUM IN STRING INSTRUMENTS. (2-0) Cr. 2. F.

368. PRACTICUM IN WOODWIND INSTRUMENTS. (2-0) Cr. 2. W.

369. PRACTICUM IN BRASS AND PERCUSSION. (2-0) Cr. 2. S. Techniques and skills required for teaching of instruments. Examination of materials for school use. For the instrumental music specialist.

*Offered on pass-fail basis only
371. HISTORY OF CHURCH MUSIC.  
(3-0) Cr. 3. F.  
Prerequisite: 355, 356, 357.  
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. F.  
Prerequisite: 355, 356, 357.  
Survey of periodic and national styles in opera.

375. HISTORY OF CHORAL MUSIC.  
(2-0) Cr. 2. W.  
Prerequisite: 355, 356, 357.  
A survey of music written for vocal ensemble in historical context.

376. HISTORY OF ORGAN.  
(3-0) Cr. 3. S.  
Prerequisite: Permission of instructor.  
Historical survey and practical study of the organ and its literature; techniques of service playing.

377. HISTORY OF SYMPHONIC MUSIC.  
(2-0) Cr. 2. W.  
Prerequisite: 355, 356, 357.  
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. F.  
Prerequisite: 355, 356, 357.  
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.

382. INTRODUCTION TO MUSICOLOGY.  
(3-0) Cr. 3. S.  
Prerequisite: 355, 356, 357.  
Goals and achievements of musicology, introduction to bibliography and research in music.

466. MUSIC EDUCATION THROUGH PERFORMANCE.  
(3-1) Cr. 3. F.  
A Vocal  
B Instrumental.  
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.

490. SPECIAL TOPICS.  
Cr. Var. F.W.S.SSI.  
Prerequisite: Permission of department head.  
A Music Education.  
B Music Theory.  
C Music Composition.  
D Music History.  
H Honors Program.  
Courses are designed to meet special interests of students and to fulfill individual requirements in specific areas, such as elementary education. Current topics include history and philosophy of music education, music for the classroom teacher, fundamentals of music, organ literature and performance, history of church music, history and performance of opera. Schedule available from Department of Music.

NUCLEAR ENGINEERING
Glenn Murphy, Ph.D., Head of Department

Professor: Donald M. Roberts, Ph.D.
Associate Professor: Richard A. Danofsky, Ph.D.; Benjamin M. Ma, Ph.D.
Assistant Professors: Achilles G. Adamantiades, Ph.D.; Paul W. Barcus, Ph.D.; Howard Bell, Ph.D.; Michael C. J. Carlson, Ph.D.; Richard A. Hendrickson, Ph.D.; Shawky F. Nassar, Ph.D.; Alfred F. Rohach, Ph.D.
Instructor: Virginia P. Denisen, B.S.

Undergraduate Study
Nuclear engineering is considered to be primarily a graduate program, hence the baccalaureate degree is not offered in this field. The undergraduate interested in a career in nuclear engineering is encouraged to complete a curriculum in one of the available fields in engineering in preparation for graduate studies in this department.

A survey course, Nuc.E. 474, is available at the undergraduate level.

Graduate Study
Major work is offered for the degrees Master of Science, Master of Engineering, and Doctor of Philosophy in nuclear engineering. Minor work in nuclear engineering and in engineering similitude is offered to students taking 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.

The foreign language requirement for the degree Master of Science may be waived upon recommendation of the head of the department.
COURSES 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

500. SPECIAL TOPICS. (2 to 5-0) Cr. 2 to 5. F.W.S.

501. ELEMENTS OF NUCLEAR ENGINEERING. (3-0) Cr. 3. F.
Prerequisite: M.E. 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. ELEMENTS OF NUCLEAR REACTOR DESIGN. (1-6) Cr. 3. S.
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.

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.

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, geo-

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.

540. ANALYSIS OF DYNAMIC SYSTEMS. (3-2) Cr. 4. F.
Prerequisite: E.M. 344, Math. 321.
Dynamic performance of engineering systems with emphasis on aperiodic conditions. Transient response of open-loop and closed-loop systems. Dynamic performance of mechanical, fluid and electrical components. Use of analog computer to obtain dynamic response.

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 plant system, stochastic methods for measurements of reactor parameters.

566. 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.
COURSES FOR GRADUATE STUDENTS, major or minor

600. RESEARCH.

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 W.
Prerequisite: 506.

611, 612, 613. ADVANCED REACTOR THEORY.
(3-0) Cr. 3 each. Yr.
Prerequisite: 537.
Advanced theory of nuclear reactors.

620. SEMINAR.
(2-0) 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.

651, 652, 653. INTERACTION OF MATERIALS AND RADIATION.
(3-2) Cr. 4 each. Yr.
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. F.W.S.
Prerequisite: 554.
A series of one-semester 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 non-linear models, analogies. Applications.

OFFICER EDUCATION PROGRAMS

Iowa State University has officer education programs in the Army, Navy, and Air Force.

The purpose of advanced ROTC is the preparation of officers to serve in the armed forces following graduation. The Navy and Air Force, in particular, are requiring a period of commissioned service long enough to encourage officers to make a career of military service. Although the Army continues to require only two years of active duty, it still expects to recruit a high proportion of its career officers from ROTC graduates. Consequently, Iowa State University views ROTC as preparation for a career in military service.

ROTC is recognized as a subject matter area of specialization. Four categories of credit allocation are now recognized:

I. A student may major in NROTC in the College of Sciences and Humanities by applying 30 credits toward the major. Six credits of basic ROTC may be applied toward the elective requirement.

II. In colleges where minors are part of the curriculum 18 credits of advanced ROTC may be applied toward the minor. Six credits of basic ROTC may be applied toward the elective requirement.

III. If a student does not select ROTC as a major or a minor, ROTC credits may, at the discretion of the college and the department, be applied toward the elective requirement.

IV. Students in Engineering Operations may follow the Army, Air Force or Navy program and apply 18 credits to the elective group requirements.

581. 582, 583. REACTOR ANALYSIS.
581: (3-0); 582: (2-2); 583: (2-2) Cr. 3 each. Yr.
Prerequisite: 537, Math. 408.
Application of numerical analysis techniques to thermal and fast reactors.

591. 592. OCEAN ENGINEERING SIMULATION.
(3-0) Cr. 3 each. W.S.
Prerequisite: E.Sci. 481.
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.
AIR FORCE AEROSPACE STUDIES

Col. Ronald L. Brumbaugh, B.S., Head of Department

Assistant Professors: Maj. Franklin E. Willis, M.A.; Maj. Elmer G. Nelson, Jr., B.A.; Capt. Donald E. Thompson, B.B.A.


Undergraduate Study

Iowa State University, a land grant institution, has offered courses in Air Force ROTC since 1946. Participation is voluntary and the student may elect either a four-year or two-year program. All physically and mentally qualified male undergraduate and graduate students are encouraged to apply for enrollment and earn a commission in the United States Air Force.

The objectives of AFROTC courses are as follows:

a. To heighten the cadet's appreciation and dedication to American principles; to give him an understanding of the Air Force's service in the national interest; and to develop his potential as a leader and his understanding of officer professionalism.

b. To provide the Air Force with officers who are dedicated to their assignment, accept responsibility willingly, think creatively, and speak and write effectively.

The two major phases of the AFROTC curriculum are the General Military Course and the Professional Officer Course. The General Military Course is normally taken during the freshman and sophomore years by four-year program cadets. As a substitute for the General Military Course, students may elect to attend a six-week field training course conducted on an Air Force base. General military training, either on campus or in six-week field training, must be completed as a prerequisite for entry into the Professional Officer Course.

All cadets must meet certain mental, physical and moral standards before being selected for the Professional Officer Course. Dependent upon physical qualification, cadets may elect a flying or non-flying category, the latter in either a technical or non-technical field. The increasing demand for highly technical positions in the United States Air Force Aerospace Program is being met principally through the AFROTC. The physical standards for non-flying officers are lower than those for pilots and navigators so that students who cannot meet the physical requirements for flying still may be accepted for training within the non-flying categories. Regardless of category, an opportunity is afforded each cadet to fly in USAF aircraft and to go on field trips to various installations throughout the United States. In addition, there is a cadet flight instruction program conducted at the Ames Airport for seniors in the pilot category. Upon passing the FAA requirements, a cadet completing this program may qualify for a private pilot's certificate.

The student is furnished a complete uniform and books while enrolled in the AFROTC program. In the Professional Officer Course he is paid $50.00 per month for a period of 20 months and is entitled to other benefits offered to regular Air Force personnel.

Field training is of four weeks' duration for cadets in the four-year program and of six weeks' duration for applicants for the two-year program. Those attending four-week field training normally do so during the summer between their junior and senior years. This training is conducted on an Air Force base and the cadet receives $160.50 per month plus travel and living expenses. The two-year program cadet attends field training during the summer preceding his final two years of undergraduate or graduate work. The Air Force pays for travel, housing and meals in addition to paying the cadet $95.70 monthly during the training period.

Financial assistance grants are available to selected cadets in the four-year program. Grants cover full tuition, a book allowance, laboratory expenses, incidental fees and $50.00 per month subsistence pay. A majority of the grants are awarded to cadets entering the second and third year of the four-year program with a few going to cadets entering the first and
fourth years. Applications for grants are accepted by the Professor of Air Force Aerospace Studies.

The AFROTC does not replace, supplement or parallel any other military training normally associated with enlistment or induction into the armed services. It is a program that is designed to provide a professional education for the career Air Force officer and to qualify for commissioning those college men who desire to serve in the United States Air Force. Students who successfully complete the program and earn a degree will receive a commission as second lieutenant in the United States Air Force.

Additional information concerning Air Force ROTC may be obtained by writing the Professor of Air Force Aerospace Studies, Iowa State University.

COURSES PRIMARILY FOR UNDERGRADUATE STUDENTS

141, 142, 143, 241, 242, 243. WORLD MILITARY SYSTEMS.
(1-0) Cr. 1 each. Yr.
A study of the nature and purpose of war, the functions and employment of the United States military forces, and the current prospects and trends in the search for world peace.

141A, 142A, 143A, 241A, 242A, 243A. CORPS TRAINING.
(0-1) Cr. R. 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.
A survey of the development of aerospace power, astronautics and space operations, and probable future 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. R. each. Yr.
Advanced leadership training pertaining to planning, organizing, supervising, conducting, inspecting, and evaluating military activities; the preparation and presentation of briefings and other oral and written communications; and the providing of counseling, guidance, information, and other services which will 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.

MILITARY SCIENCE

Col. Robert B. Barnett, B.S.; Head of Department

Assistant Professors: Maj. Charles L. Milhorn, B.S.; Capt. Dennis B. Lewis, B.S.; Capt. Raymond F. Tutton, B.A.; Capt. Lee A. Waltrip, B.S.

Instructors: 1/Sgt. Frank L. Fuller; SFC. Patrick T. Neely.

The United States Army ROTC Program is designed to prepare students for positions of leadership and responsibility. The program enables students to perform their military service as officers according to their preferences. With this ROTC program, the graduate is qualified to serve the minimum period of 2 years, an intermediate time of up to 20 years, or to pursue a full career of 30 years as a regular army officer.

All cadets completing the program and baccalaureate degree requirements are commissioned as second lieutenants in the U.S. Army. Those qualifying as Distinguished Military Students during their senior year may apply for regular army commissions.
Special Considerations

1. Military science may be pursued through four years of college, or the student may elect to substitute a six-week summer camp at the end of his sophomore year in lieu of the 100- and 200-level subjects, which are normally taken during the freshman and sophomore years.

2. Two- and four-year scholarships are available for qualified individuals. These scholarships pay tuition, laboratory fees, $50 per month, and the cost of all course books.

3. All cadets enrolled in the 300- and 400-level military science courses for the purpose of earning a commission are paid $50 per month and receive tailored uniforms valued at $150. Including the amount of pay during the junior year summer camp, the non-scholarship cadet receives a total remuneration of approximately $1,300.

4. Qualified cadets may participate in a flight training program during their senior year for the purpose of becoming army aviators.

5. During the senior year the cadet is given an opportunity to state his first, second and third choices of branch assignment from within 14 different branches of the Army.

6. Senior cadets may request a delay in reporting for active duty after commissioning for the purpose of graduate study. Qualified individuals have been granted delays of up to five years to acquire doctoral degrees.

Undergraduate Study

Army ROTC students seeking a commission may elect military science as a minor and pursue any curriculum leading to a baccalaureate or higher degree.

Military science courses are designed primarily for students seeking a commission in the United States Army; however, any student may enroll in a particular military science course, subject to the approval of the professor of military science and the availability of classroom space, since priority will be given to students pursuing the commissioning program.

COURSES PRIMARILY FOR UNDERGRADUATE STUDENTS

101. MILITARY SCIENCE I - PRINCIPLES OF MILITARY ORGANIZATION.
(1-0) Cr. 1. F.
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 relationships 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. F.W.S.
Initial military training to provide experience in leadership; to teach the customs and courtesies of the service

201. MILITARY SCIENCE II - LAND NAVIGATION.
(2-0) Cr. 2. F.
Prerequisite: 101, 102, 103 or approval of professor of military science.
Characteristics and features of the earth's landmass and application of methods of conducting navigation on land by use of topographical maps and aerial photographs

202. MILITARY SCIENCE II - AMERICAN MILITARY HISTORY.
(3-0) Cr. 3. W.
Prerequisite: 101, 102, 103 or approval of professor of military science.
A historical study of the development of land warfare, the evolution of United States military policy, modernization of the United States Army.

203. MILITARY SCIENCE II - MILITARY TACTICS.
(2-0) Cr. 2. S.
Prerequisite: 101, 102, 103 or approval of professor of military science.
Actions and attitudes applied in both nuclear and non-nuclear 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. F. W. S.
Prerequisite: 103A.
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: 201, 202, 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 communications.

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.
The 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. F. W. S.
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 weeks 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: 301, 302, 303.
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.
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. F. W. S.
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.

NAVAL SCIENCE
Capt. James H. McGhee, USN, M.A., Head of Department

Associate Professor: Maj. Billy D. Kraxberger, USMC, B.S.
Instructors: GySgt. Francis A. Ardine, USMC; QMC. Gary L. Peck, USN; GMG1. Jimmy L. Stone, USN.

The first Naval Reserve Officers Training Corps units were established in 1926. There are now 54 units in various colleges and universities throughout the United States. Iowa State University is the only institution of higher learning in the state of Iowa which has an NROTC unit.

The function of the Naval Reserve Officers Training Corps is to provide, by a permanent system of training and instruction in essential naval subjects at civil educational institutions, a source from which qualified officers may be available for the Navy and the Marine Corps and the Naval Reserve and the Marine Corps Reserve.

There are two types of NROTC enrollees, the Regular and the Contract. The programs are similar in that all students pursue studies of their choice leading to a baccalaureate degree and in addition take one naval science course each quarter; however, limited quotas are established by the Department of the Navy for both programs. Candidates for the Regular program are selected in the spring preceding the freshman year after having passed a nationwide
aptitude test and physical examination. Contract students normally apply after graduation from high school and are selected during fall orientation days.

Also, a two year program is available for students who have successfully completed their sophomore year. For further information, contact the Naval Science Department.

In addition to completing the prescribed naval science course, each midshipman enrolled in the NROTC must fulfill the following additional course requirements:

a. By the end of the junior year, all NROTC students must have satisfactorily completed one year of college calculus (or statistics in certain curricula), one year of college physics or chemistry, and one quarter of computer science.

b. Prior to graduation and commissioning, all NROTC students must have satisfactorily completed a course in American Military Affairs and a course in National Security Policy.

c. Every student must achieve proficiency in written and oral expression in accordance with the standards prescribed by the University.

NROTC students are not required to major in naval science. Regular NROTC students may take any course leading to a baccalaureate or higher degree except the following: agronomy, animal husbandry, animal science, art, dairy husbandry, dairy manufacturing, dairy production, dentistry, dramatics, entomology, floriculture, general agriculture, horticulture, hotel administration, industrial arts, landscape architecture, law, medicine, music, optometry, pharmacy, physical education, poultry husbandry, pre-dental, pre-medicine, pre-theological, pre-veterinary, real estate, religion, soil conservation, soils, theology, veterinary medicine, wildlife management.

Contract students may take any course leading to a baccalaureate degree. However, this program is not recommended for medical, dental or theological students. Recommended fields of study for NROTC students are engineering, mathematics, physical or social sciences, and industrial administration.

The general objectives of the program are:

1. To assist in the education of the midshipman in a major field of study of interest to the Navy or Marine Corps leading to a baccalaureate degree.

2. To provide the midshipman with the fundamental concepts and principles of Naval Science and with the professional Naval knowledge necessary to establish a sound basis for his future growth as a Naval or Marine Corps officer.

3. To prepare the midshipman for service with the highest sense of honor and integrity as a commissioned officer, to cultivate the essential elements of military leadership, and to foster the growth of a strong sense of loyalty and dedication to his service and to the Nation.

4. To prepare the midshipman to undertake successfully in later periods of his career, advanced/continuing education in a field of application and interest to the Naval Service.

5. To inject the values of civilian higher education into the Naval Service by utilizing the expertise of civilian faculty instruction where applicable.

**Undergraduate Study**

For basic undergraduate curriculum in sciences and humanities, major in naval science, leading to the degree Bachelor of Science, see *Sciences and Humanities, Curriculum*

The following are required for students with a major in naval science

N.S. 211, 212, 213, 311, 312, 313, 371, 372, 411, 412, and 413A, with minors in mathematics and choice of physics or engineering curricula. Three quarters of physics must be included, and the following courses should be included in group requirements or electives: Geog. 201 or 322; E.E. 341, 342; Hist. 221, 222, 223; Pol. S. 556; E. Gr. 161, 162; Chem. 101, 102, 103. 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.

Naval science courses are primarily for those students enrolled in the NROTC program. Other students may enroll for naval science courses with the approval of the head of department.
COURSES PRIMARILY FOR UNDERGRADUATE STUDENTS

111, 112, 113. PRINCIPLES OF NAVAL ORGANIZATION AND MANAGEMENT, AND INTRODUCTION TO NAVALSHIP SYSTEMS. (3-2) Cr. 3 each Yr.
Principles of naval organization and management. Naval organization and management practices and the concepts that lie behind them examined within the context of American social and industrial organization and practice. Emphasis on management and leadership functions. Introduction to naval ship systems. Familiarization with the types, structures, and purposes of naval ships. Ship compartmentation, propulsion systems, auxiliary power systems, interior communications, and ship control.

211. SEAPower AND MARITIME AFFAIRS SEMINAR AND MILITARY DRILL. (1-1) Cr. 1. F.
Military drill period required for NROTC students only.

212. SEAPower AND MARITIME AFFAIRS SEMINAR. (2-0) Cr. 2. W.

213. MILITARY DRILL. (0-2) Cr. R.S.
Open to NROTC students only.

311M.EVOLUTION OF THE ART OF WAR. (3-2) Cr. 3. Alt. F. Offered 1969.
Evolution of the art of land warfare from Alexander the Great to the Civil War.

United States military history from the Civil War to the present with special emphasis on the evolution of United States military policy.

313M.STRATEGY AND TACTICS. (3-2) Cr. 3. Alt. S. Offered 1970.
Principles of strategy and tactics, with emphasis on their relationship to military and national policy, followed by a more detailed consideration of small unit field tactics.

311, 312, 313. NAVIGATION AND NAVAL OPERATIONS. (3-2) Cr. 3 each Yr.

371, 372. AMERICAN MILITARY AFFAIRS I & II. (3-0) Cr. 3 each F.W.
A survey of military affairs in the United States from the American Revolution to the present to include the themes. Transformation from the earlier limited wars to the total wars of our own times, origins and evaluation of American military policy. Relationship between our military, social, political and economic systems, civil-military relations in peace and war; evaluation of the concept of modern total war.

373. NATIONAL SECURITY POLICY. (3-0) Cr. 3. S.
An analysis of U.S. National Security Policy to include consideration of the development of U.S. defense structure; formulation and implementation of U.S. security policy; role of each governmental component concerned with security affairs; review of the elements of national power.

411M.EVOLUTION OF UNITED STATES AMPHIBIOUS WARFARE. (3-2) Cr. 3. Alt. F. Offered 1970.
United States amphibious warfare from the founding of our country to the present with emphasis on the evolution of equipment and techniques.

412M.ANALYSIS OF AMPHIBIOUS FORCES. (3-2) Cr. 3. Alt. W. Offered 1971.
The various arms composing amphibious forces, and the planning and execution of an amphibious operation.

413M. THE UNIFORM CODE OF MILITARY JUSTICE AND LEADERSHIP TECHNIQUES. (3-2) Cr. 3. Alt. S. Offered 1971.

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 SYSTEM. (3-2) Cr. 3. S.
Similar to 413A. For students without preparation in calculus.
Undergraduate Study

Philosophy is the study of the dominant ideas and 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: 430, 431, 455, 456, 457, 458, 460, 461, 462, 470, 480, 481, 495.

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.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.S.S.SII.
Elements of logical criticism: Principles of evidence, proof, definition, and meaning.

321. THE OLD TESTAMENT.
(3-0) Cr. 3. F.W.
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.S.
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. RECENT AND CONTEMPORARY PHILOSOPHY.
(4-0) Cr. 4. S.
Prerequisite: 342.
Philosophical developments in the nineteenth and twentieth centuries. Principal movements in idealism, realism, pragmatism, positivism, existentialism, and logical analysis.
438 Courses and Programs

365. INTRODUCTION TO EXISTENTIALISM. (3-0) Cr. 3. F.W.
Systematic examination of the views of such men as Kierkegaard, Marcel, Heidegger and Sartre

370. SYMBOLIC LOGIC. (3-0) Cr. 3. F.W.S.
Introduction to propositional and predicate calculus as well as intuitive set theory. Some applications to philosophy and the foundations of mathematics.

430. 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.

431. CONTEMPORARY ETHICAL THEORY. (3-0) Cr. 3. W.
Prerequisite: 231.
Theoretical and normative issues in contemporary ethical thinking.

455. 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 reformation, the Counter Reformation, the modern sectarian 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.

456. ORIENTAL RELIGIOUS PHILOSOPHY. (3-0) Cr. 3. F.S.
Prerequisite: 200 or 260.
Origin and historical development of the chief Oriental religions: Hinduism, Buddhism, Confucianism, Taoism, Shintoism. Significance of religious thought in understanding Oriental culture contrast between Oriental and Western views of man, God, nature, history, ethics.

457. PHILOSOPHY OF RELIGION. (3-0) Cr. 3. F.S.
Prerequisite: 200 or 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.

458. CONTEMPORARY CHRISTIAN THEOLOGY. (3-0) Cr. 3. S.
Prerequisites: 200 or 260.
Selected theologians, and theological issues in contemporary Christianity, both Protestant and Roman Catholic.

460. CONTINENTAL RATIONALISM. (3-0) Cr. 3. W.
Prerequisite: 342.
Critical exposition of seventeenth century rationalism as developed by Descartes, Spinoza and Leibniz.

461. THE EMPIRICIST TRADITION. (3-0) Cr. 3. S.
Prerequisite: 342.
Critical exposition of British empiricism as developed by Locke, Berkeley and Hume.

462. EPISTEMOLOGY AND METAPHYSICS. (3-0) Cr. 3. F.
Prerequisite: 342.
Some central problems in epistemology and metaphysics: Concepts, meaning, truth, logical and causal necessity, substance, mind, space and time, determinism and freedom.

470. PHILOSOPHICAL ISSUES IN LOGIC. (3-0) Cr. 3. F.
Prerequisite: 370.
Philosophical problems in logical theory and foundations of mathematics.

480. 481. PHILOSOPHY OF SCIENCE. (3-0) Cr. 3 each.
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.

495. SPECIAL PROBLEMS. Cr. 2 to 5 each time elected.
Prerequisite: Permission of instructor.
Reading course in special topics to meet the individual needs of advanced students.

PHYSICAL EDUCATION FOR MEN

James P. Reid, M.A., Head of Department


Associate Professors: Ray O. Donels, M.A.; Edward R. Gagnier, M.A.; Jack M. McGuire, B.S.; Leo R. Schneider, M.S.; George C. Stapleton, B.S.; Clayton Sutherland, B.A.

Assistant Professors: Glendon R. Anderson, B.S.; Raymond Bickerstaff, M.Ed.; Wallace W. Hutchison, M.S.; Robert L. Lawson, M.S.; John T. Majors, B.S.; W. Burton Moore, M.S.; Lynn J. Reading, M.S.; Arch Steel, M.A.

Undergraduate Study

Two curricula, both leading to the degree Bachelor of Science, are available to the student. The curriculum in Sciences and Humanities with a major in physical education for men is described in the section College of Sciences and Humanities under the heading Curriculum in Sciences and Humanities. The second curriculum is outlined in the same section under the heading Curriculum in Physical Education for Men. Both curricula prepare the student to teach physical education, to coach athletics, or to direct recreational programs for schools, camps, industries and communities. For teaching and coaching, see Index.

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 participates, and 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.

The facilities of the department include 21 tennis courts, ice-skating area, playfields, State Gymnasium with pool, Beyer Hall with pool, handball courts, squash courts, wrestling room, gymnastics room and individual exercise room.

All freshman courses must be used to satisfy the physical education requirement.

COURSES PRIMARILY FOR UNDERGRADUATE STUDENTS

Basic Instruction Program Courses

101. FOUNDATIONS OF PHYSICAL EDUCATION.
(0-2) Cr. 1. F.
Classification and orientation in physical education activities.

110. PRESCRIBED INDIVIDUAL ACTIVITIES.
(0-2) Cr. 1. F.W.S.
Prerequisite: Prescription of Student Health Services.

Aquatics

111. BEGINNING SWIMMING I.
(0-2) Cr. 1. W.S.SSIII.

112. BEGINNING SWIMMING II.
(0-2) Cr. 1. F.W.S.SSIII.

113. WATER POLO AND RELATED SPORTS.
(0-2) Cr. 1. W.S.

114. LIFE SAVING.
(0-2) Cr. 1. W.S.

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.

115. WATER SAFETY.
(0-2) Cr. 1. F.W.S.
Leads to certification as a Red Cross water safety instructor.

116. SKIN AND SCUBA DIVING.
(0-2) Cr. 1. F.W.S.
Prerequisite: Expert swimmer classification.

Team Sports

122. BASKETBALL.
(0-2) Cr. 1. W.

125. VOLLEYBALL.
(0-2) Cr. 1. F.W.S.

Combatives

133. FENCING.
(0-2) Cr. 1. F.W.S.

135. WRESTLING I.
(0-2) Cr. 1. F.W.

136. WRESTLING II.
(0-2) Cr. 1. F.W.
Techniques and practice.
Individual Recreational Sports

141. ARCHERY. (0-2) Cr. 1. F.W.S.SSI.
142. BADMINTON. (0-2) Cr. 1. F.W.S.
144. BAITCASTING. (0-2) Cr. 1. F.S.
147. BOWLING. (0-2) Cr. I. F.W.S.
149. GOLF I. (0-2) Cr. 1. F.S.SSI.SSII.
150. GOLF II. (0-2) Cr. 1. F.S.SSI.SSII.

Leadership Activities

162. SPORTS OFFICIATING. (0-2) Cr. 1. F.W.S.
A. Football.
B. Basketball.
C. Softball.

Co-Educational Activities

173. SQUARE DANCING. (0-2) Cr. 1. F.W.S.

Varsity Sports

190. SPORTS PARTICIPATION. Cr. 1 each.
Transfer to freshman and varsity sport squads upon permission of coach
A. Band. F.
B. Baseball, F.S.
C. Basketball, F.W.

Professional Program Courses

200. INTRODUCTION TO PHYSICAL EDUCATION. (3-0) Cr. 3. F.S.
Leadership techniques, aptitudes, measurements and orientation in the general areas of physical education

201. AN INTRODUCTION TO SUPERVISED RECREATION. (3-0) Cr. 3. F.S.SSI.
Importance of wholesome recreation in total personal development and introduction to the vocational opportunities in and requirements of recreation leadership

202. HISTORY OF PHYSICAL EDUCATION. (3-0) Cr. 3. F.S.
Prerequisite: 200.
Evolution of modern physical education, its many activities, its place in the educational pattern of each period.

205. SUPERVISED TEACHING IN PHYSICAL EDUCATION. (0-2 or 4) Cr. 1 or 2. F.W.S.SSI.SSII.
Prerequisite: 200.
Observation and practice in teaching situations

212. GYMNASTICS. (1-4) Cr. 3. F.W.S.SSI.
Techniques and theory of gymnastic activities, including tumbling and apparatus

214. FOOTBALL TECHNIQUES. (1-4) Cr. 3. F.W.
Instruction and practice in fundamental skills of football

215. BASKETBALL TECHNIQUES. (1-4) Cr. 3. W.
Instruction in the fundamental skills and methods of coaching basketball.

216. TRACK AND FIELD TECHNIQUES. (1-4) Cr. 3. S.SSI.
Instruction in the fundamental skills of track and field events; rules and officiating.

217. BASEBALL TECHNIQUES. (1-4) Cr. 3. S.
Instruction and practice in fundamental skills of baseball.

218. ADVANCED SWIMMING TECHNIQUES. (1-4) Cr. 3. W.S.SSI.
Prerequisite: Ability to pass First Grade swimmer's test.
Instruction and practice in all swimming skills, life saving and methods of teaching such skills.

219. WRESTLING TECHNIQUES. (1-4) Cr. 3. F.W.
Instruction and practice in the skills of wrestling and methods of teaching those skills

220. PHYSICAL EDUCATION ACTIVITIES. (1-4) Cr. 3. F.S.SSI.
Instruction in the skills and methods of teaching soccer, speedball, golf and tennis.

221. PHYSICAL EDUCATION ACTIVITIES. (1-4) Cr. 3. W. SSII.
Instruction in the skills and methods of teaching archery, badminton, and volleyball.
316. TRACK AND FIELD COACHING.
   (1-2) Cr. 2 each. F.W.S.SSI.SSII.
   Basic philosophy and principles of officiating, requirements of an official; techniques and mechanics of officiating in athletic contests; practical experience in the intramural program.
   230. Football (F)
   231. Basketball (W)
   232. Baseball (S.SSI.SSII)

283. LEADERSHIP IN SUPERVISED RECREATION.
   (0-3 or 6) Cr. 1 or 2. F.W.S.
   Prerequisite: 201, sophomore classification.
   Observation of and practice with community recreation groups.

305. SUPERVISED TEACHING IN PHYSICAL EDUCATION.
   (0-2 or 4) Cr. 1 or 2. F.W.S.SSI.SSII.
   Prerequisite: 205.
   Observation and practice in teaching situations.

314. FOOTBALL COACHING.
   (3-0) Cr. 3. W.SSI.
   Prerequisite: 214.
   History, rules, theory, coaching methods.

315. BASKETBALL COACHING.
   (3-0) Cr. 3. F.SSII.
   Prerequisite: 215.
   History, rules, theory, coaching methods.

316. TRACK AND FIELD COACHING.
   (3-0) Cr. 3. W.
   Prerequisite: 216.
   History, rules, theory, coaching methods.

317. BASEBALL COACHING.
   (3-0) Cr. 3. S.
   Prerequisite: 217.
   History, rules, theory, coaching methods.

320. ATHLETIC TRAINING.
   (1-4) Cr. 3. W.S.
   Prerequisite: Zool. 155, junior classification.
   Principles governing conditioning for various sports; diet, sleep, bathing, massage; over-training; prevention and care of injuries.

340. ORGANIZATION AND ADMINISTRATION OF INTRAMURAL ATHLETICS.
   (3-0) Cr. 3. W.SSII.
   Prerequisite: 260.
   Conduct and direction with special emphasis on place at the secondary level.

350. SOCIAL RECREATION.
   (1-4) Cr. 3. S.
   Prerequisite: 201.
   Leadership techniques in teaching low organized games; rhythm activities and social mixers.

351. OUTDOOR RECREATION.
   (1-4) Cr. 3. F.
   Prerequisite: 201.
   Conservation and proper use of outdoor facilities and resources; methods of leadership in camping; camping skills.

352. SUPERVISED RECREATION PROGRAM DEVELOPMENT.
   (2-2) Cr. 3. W.
   Prerequisite: 201, sophomore classification.
   Principles and procedures in recreational programming.

353. ORGANIZATION AND ADMINISTRATION OF SUPERVISED RECREATION.
   (3-0) Cr. 3. S.
   Prerequisite: 352, junior classification.

Techniques of leadership, organizational and administrative procedures in recreation programs.

383. LEADERSHIP IN SUPERVISED RECREATION.
   (0-3 or 6) Cr. 1 or 2. F.W.S.
   Prerequisite: 283, 352, junior classification.
   Observation of and practice with community recreation groups.

391. PRINCIPLES OF PHYSICAL EDUCATION.
   (3-0) Cr. 3. F.SSII.
   Prerequisite: 200, Educ. 204.
   Current philosophies with special reference toward the development of a personal philosophy for physical education.

405. SUPERVISED TEACHING IN PHYSICAL EDUCATION.
   (0-2 or 4) Cr. 1 or 2. F.W.S.SSI.SSII.
   Prerequisite: 305, Educ. 305A.
   Observation and practice in teaching situations.

483. LEADERSHIP IN SUPERVISED RECREATION.
   (0-3 or 6) Cr. 1 or 2. F.W.S.
   Prerequisite: 383, senior classification.
   Field work in a responsible position of recreation leadership with community recreation groups.

490. SPECIAL PROBLEMS.
   (Arr.) Cr. var. F.W.S.SSI.SSII.
   Prerequisite: senior classification or permission of chairman.
   1. Physical Education
   2. Health
   3. Recreation

492. HUMAN RELATIONSHIP ASPECTS OF COACHING.
   (3-0) Cr. 3. F.
   Prerequisite: Senior classification, qualification for practice teaching.
   Factors necessary for effective human relations in successful coaching.

495. PROGRAM DEVELOPMENT IN PHYSICAL EDUCATION.
   (2-2) Cr. 3. W.
   Prerequisite: Senior classification, credit or classification in 497.
   The ideal secondary school program, adaptation of the ideal to meet changing needs and local situations.

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.
   (3-0) Cr. 3. W.
   Prerequisite: 391, Psych. 333.
   Application of general educational methods to physical education. Special methods of teaching activities not covered in 314, 315, 316, 317.

498. ADMINISTRATION OF ATHLETICS AND PHYSICAL EDUCATION.
   (3-0) Cr. 3. S.SSII.
   Prerequisite: 397, senior classification.
   Administrative policies and procedures. Current problems and practices in the basic instruction and athletic programs in the secondary school.
PHYSICAL EDUCATION FOR WOMEN
Barbara E. Forker, Ph.D., Head of Department

Professors: Germaine G. Guiot, Ed.D.; Waldean A. Robichaux, Ph.D.; Betty L. Toman, M.S.
Assistant Professors: Madge H. Bowers, B.S.; Luzonne Darr, M.A.; Patricia D. Downie, M.S.; Betty A. Keenan, M.A.


Undergraduate Study
For undergraduate curriculum in physical education for women leading to the degree Bachelor of Science, see Home Economics, Curricula. See College of Sciences and Humanities for group requirements leading to a Bachelor of Science 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 elementary and secondary schools. An undergraduate degree in physical education provides the necessary background for degrees in physical therapy and occupational therapy.

Students enrolled in the department must apply to and be accepted by the departmental committee on selection and the College of Education Committee on Academic Standards in order to advance to the teacher education program. For the teacher education program, including requirements for teaching certification, see College of Education.

The department offers, in addition, a wide selection of activities from which students fulfill their requirement. Upperclassmen may elect additional courses in physical education. Through the intramural and club programs, every woman is given an opportunity to participate in activities throughout her college years and unusual opportunities for the development of recreational interests are provided. The indoor facilities found in the women's building include a gymnasium dance studio, individual activity room, swimming pool, and indoor golf and archery ranges. Out-of-doors facilities include a sodded 17-acre women's playfield and eight hard-surfaced tennis courts.

The purpose of the required physical education program is to aid the student in gaining an appreciation and knowledge of the importance of exercise in daily living. Participation in activities offered in the program should enable students to maintain and improve personal fitness during their college years. Through the instructional program, the student develops skill in leisure-time activities according to her choice and ability. A medical examination is required and evaluated by the medical staff of the Student Health Service. If special posture education or a restricted activity program is found necessary for a student, the department provides activities adapted to individual needs.

Students are required to enroll in physical education for consecutive quarters, until the credit requirement of their college is completed.

COURSES PRIMARILY FOR UNDERGRADUATE STUDENTS

Beginning Courses

Aquatics

101. SWIMMING I.
    (0-3) Cr. 1. F.W.S.SSII. SSI.
    Basic course for nonswimmers. Adjustment for deep water swimming

Rhythmic

116. BEGINNING MODERN DANCE.
    (0-3) Cr. 1. F.W.S.

117. FOLK DANCE.
    (0-2) Cr. 1. F.W.S.

102. SWIMMING II.
    (0-3) Cr. 1. F.W.S.SSII. SSI.
    Prerequisite: 101 or equivalent skill.
    Beginning swimming course. Emphasis on front crawl, elementary back stroke and side stroke

118. AMERICAN COUNTY DANCE.
    (0-2) Cr. 1. F.W.S.
Team Sports

125. HOCKEY. (0-3) Cr. 1. F.
126. VOLLEYBALL. (0-2) Cr. 1. F.W.S.

Individual Sports and Activities

130. BEGINNING TENNIS. (0-3) Cr. 1. F.S.S.S.I.S.S.I.
133. BEGINNING BADMINTON. (0-3) Cr. 1. W.
135. BEGINNING GYMNASTICS. (0-3) Cr. 1. F.W.
136. ARCHERY. (0-3) Cr. 1. F.W.S.S.S.I.
138. BEGINNING BOWLING. (0-2) Cr. 1. F.W.
140. BEGINNING GOLF. (0-3) Cr. 1. F.S.S.S.I.S.S.I.
143. POSTURE EDUCATION. (0-3) Cr. 1. F.W.

Intermediate and Advanced Courses

Aquatics

201. SWIMMING III. (0-2) Cr. 1. F.W.S.S.S.I.S.S.I.
Prerequisite: 102 or equivalent skill.
Perfection of basic strokes. Introduction to breast and trudgen strokes
202. SWIMMING IV. (0-2) Cr. 1. F.W.S.S.S.I.S.S.I.
Prerequisite: 201 or equivalent skill.
Perfection of all strokes. Diving skill necessary for springboard diving
203. LIFE SAVING. (0-3) 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 18. Current Senior Life Saving Certificate. Advanced swimming certificate or equivalent skill.

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.

Rhythmic

210. MODERN DANCE COMPOSITION. (0-2) Cr. 1. F.W.
Prerequisite: 110 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.
211. CONCERT MODERN DANCE. (0-2) Cr. 1. W.
Prerequisite: Permission of the instructor. Improvement of performance skill and practical adaption in composition.

212. TECHNIQUES OF MODERN DANCE. (0-2) Cr. 1. F.W.
Prerequisite: 110 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.
213. ADVANCED MODERN DANCE. (0-3) Cr. 1. F.S.
Prerequisite: 210, 212. Instruction and practice of advanced modern dance technique, composition and improvisation.
Courses and Programs

Individual Sports and Activities

230. INTERMEDIATE TENNIS.
   (0-2) Cr. 1. F.S.
   Prerequisite: Completed beginning tennis course
   on college level or instructor's permission.

231. ADVANCED TENNIS.
   (0-2) Cr. 1. F.S.
   Prerequisite: 230 or permission of instructor.
   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.
   (0-2) Cr. 1. W.
   Prerequisite: Completed beginning badminton
   course on college level or instructor's permis­
   sion.

235. INTERMEDIATE BADMINTON.
   (0-2) Cr. 1. S.
   Prerequisite: Beginning badminton or permis­
   sion of instructor.
   Instruction and practice of more advanced
   skills in tumbling and apparatus

238. INTERMEDIATE BOWLING.
   (0-2) Cr. 1. F.W.S.
   Prerequisite: 138 and/or preliminary test.
   Instruction and practice in the more advanced
   skills and techniques involved in bowling. In­
   troduction of the hook and curve ball releases
   and technical aspects involved in picking up
   spares. Organization and administration of com­
   petition in bowling.

240. INTERMEDIATE GOLF.
   (0-4) Cr. 1. F.S.
   Prerequisite: Completed beginning golf course
   on college level or professional lessons and
   practice on a golf course.

246. INTERMEDIATE FENCING.
   (0-3) Cr. 1. W.S.
   Prerequisite: 146 or permission of instructor.
   Instruction and practice in the more advanced
   skills and techniques. Introduction of the Fleche
   and Falestra attacks.

Upon completion of the physical education require­
ment, 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

313. PRACTICUM IN MODERN DANCE.
   (0-2) Cr. 1 each time elected with a maximum
   of 3 credits. F.W.S.
   Prerequisite: 211 or permission of instructor.
   Practice of performing skills and choreography
   involved in dance as a performing art.

356. CAMPING AND OUTDOOR
   EDUCATION.
   (3-0) Cr. 3. S.
   Prerequisite: 3 credits required physical edu­
   cation.
   Introduction to camping, objectives, organized
   camp programs, methods of leadership and know­
   ledge of camp craft skills, culminating in cook­
   outs 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. S
   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.

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. Em­
   phasis on adaptation of activities, methods and
   program planning. Opportunity for observation.
   Two all-day field trips.

Professional Program Courses

150. 151, 152. FUNDAMENTALS OF
      PHYSICAL EDUCATION ACTIVITIES.
      (0-3) Cr. 1 each. F.W.S.
      Skills, strategy, rules of selected activities. Em­
      phasis placed on individual performance 150.
      Badminton, Tennis 151 Basketball, Volleyball
      152: Archery, Golf

165. FUNDAMENTALS OF MODERN DANCE.
      (0-3) Cr. 1. F.S.
      Instruction and practice in the fundamental tech­
      niques 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.
      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. Em­
      phasis placed on individual performance 250:
      Field Sports. 251: Gymnastics. 252: Softball,
      Track, Field.

269. 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.

270, 271. OFFICIATING.
      (1-3) Cr. 2 each. F.W.
      Prerequisite: 150, 151, 152.
      Techniques and practice in officiating physical
      education activities. 270: Volleyball, Swimming.
      271. Basketball.
275. PROGRAM DEVELOPMENT IN PHYSICAL EDUCATION.
(3-0) Cr. 3. F.S.
Prerequisite: 190.
Principles of developing and planning programs of secondary school physical education

310. DANCE PRODUCTION I.
(1-2) Cr. 1. F.
Prerequisite: 211 or permission of instructor.
Principles of dance concert production and program planning.

311. DANCE PRODUCTION II.
(1-3) Cr. 2. W.
Prerequisite: 310.
Work in rehearsing and producing a dance concert.

370. PRINCIPLES OF MOTOR PERFORMANCE.
(3-0) Cr. 3. F.
Prerequisite: 275, Phys. 106.
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: 161, 250, 262, 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.

385. TECHNIQUES AND METHODS IN SOCIAL, FOLK, AND SQUARE DANCE.
(1-2) Cr. 2. F.
Prerequisite: 118, 165.
Theory and practice of skills involved in executing and teaching social, folk, and square dance. Analytical study of the rhythmic structure inherent in these dance activities.

386. METHODS OF TEACHING MODERN DANCE.
(2-3) Cr. 3. S.
Prerequisite: 165, 376 or permission of instructor.
Problems, methods and materials related to teaching dance technique, composition, choreography and direction of a performing group.

399. PROFESSIONAL RELATIONS.
(0-0) Cr. R. S.
Prerequisite: 376.
Personal, professional and public relations in education.

417. SUPERVISED TEACHING IN PHYSICAL EDUCATION IN THE SECONDARY SCHOOLS.
Cr. 4-12. F.W.S.
Prerequisite: 370, Educ. 305.
Supervised teaching in the secondary schools.

418. SUPERVISED TEACHING IN PHYSICAL EDUCATION IN THE ELEMENTARY SCHOOL.
Cr. 2-5. F.W.S.
Prerequisite: 370, 473, Educ. 305.
Supervised teaching in the elementary schools.

420. ORGANIZATION OF PHYSICAL EDUCATION PROGRAMS.
(3-0) Cr. 3. 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. W. 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.

472. CREATIVE RHYTHMIC ACTIVITIES FOR ELEMENTARY SCHOOL CHILDREN.
(1-2) Cr. 2. W.
Prerequisite: 269.
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.

473. GAMES AND ACTIVITIES FOR ELEMENTARY SCHOOL CHILDREN.
(1-2) Cr. 2. S.
Prerequisite: 269, 472.
Methods of teaching games, self-testing activities and gymnastics in the elementary school. Open to physical education majors in K-12 certification program.

480. SCIENTIFIC BASES OF PHYSICAL EDUCATION.
(3-3) Cr. 4. W.
Prerequisite: 370, Zool. 155, 359.
Exercise physiology Adapted physical education

490. SPECIAL PROBLEMS.
Cr. 1 to 3 in any one quarter. F.W.S.
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.

495. SEMINAR IN PHYSICAL EDUCATION.
(2-0) Cr. 2. S.
Prerequisite: Senior standing.

COURSE PRIMARILY FOR GRADUATE STUDENTS, major or minor, open to qualified undergraduates

590W. SPECIAL TOPICS.
(Educ. 590W) See Education.
PHYSICS

Daniel J. Zaffarano, Ph.D., Chairman of Department


Instructors: Benjamin S. Cooper, Ph.D.; James E. Dixon, A.B.; Russell A. Phillips, Ph.D.; Dennis K. Ross, Ph.D.; Timothy K. Wagner, Ph.D.

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 baccalaureate 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 comprises 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, 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. 103, 110, 111, 112, 213, 321, 322, 404, 409, 410, 411; Chem. 101, 102, 103 or 107, 108. Work equivalent to Math. 103 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 major work for the degrees Master of Science and Doctor of Philosophy in four separate fields: nuclear physics, solid state physics, astrophysics, and high energy physics. Facilities of the department and of the Institute for Atomic Research, with
which it is 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 above for undergraduate physics majors. 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. Acceptable physics credits are listed below. At least 17 of the credits in physics must be in courses at the 500 or 600 level, exclusive of 640 and 690. Students choosing a degree with thesis may take up to 12 credits of 690, but no credits of 640 are to be applied toward the degree. Students choosing a degree without thesis should take one credit per quarter of 640 (Tutorial Physics), but may not apply research credits in 690 toward the degree. There is no foreign language requirement.

The department recommends that Ph.D. students seeking a minor in physics include in their program at least 18 credits of physics courses open to graduate students for minor credit, and that at least nine of these credits be at the 500 or 600 level.

Open to graduate students for minor or M.S. major credit: 304, 344, 345, 346, 354, 355, 394, 411, 421, 422, 423, 490, 494, 495, 496.

COURSES PRIMARILY FOR UNDERGRADUATE STUDENTS

101. FOUNDATIONS AND FRONTIERS OF PHYSICS.
   (4-0) Cr. 4. F.W.S.
   An essentially non-mathematical 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. Yr.
   Prerequisite: Math. 101C.
   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

134, 135, 136. EXPERIMENTAL PHYSICS I.
   (0-2) Cr. 1 each. Yr.
   Prerequisite: Credit or classification in Math. 110.

151. 152, 153. INTRODUCTION TO ASTRONOMY.
   (2-0) Cr. 2 each. Yr.
   Prerequisite: Math. 101C.
   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 nebulae.

221, 222, 223. INTRODUCTION TO CLASSICAL PHYSICS.
   (5-0) Cr. 5 each. F.W.S.S.
   Prerequisite: 221: Credit or classification in Math.

301, 302, 303. MODERN PHYSICS.
   (3-0) Cr. 3 each. Yr.
   Prerequisite: 223, credit or classification in Math. 213. For physics majors.

321, 232, 233. INTRODUCTION TO MODERN PHYSICS.
   (3-0) Cr. 3 each. Yr.
   Prerequisite: 223, credit or classification in Math. 213. For physics majors.

324, 235, 236. EXPERIMENTAL PHYSICS II.
   (0-3) Cr. 1 each. Yr.
   Prerequisite: 223, credit or classification in Math. 213.

Physics 447
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 elected. W.S.
Prerequisite: 233, Math. 213.
Experiments in classical and modern physics Emphasis upon planning of experimental procedures

344, 345. GENERAL ASTRONOMY I, II.
(3-0) Cr. 3 each. F.W.
Prerequisite: 344: 223, or 113 and permission of instructor; 345: 344. 344: Astronomical instruments, techniques and fundamental data. The solar system 345 Stellar astronomy. Variable stars, binaries, multiple star systems. Star clusters; Galactic structure

346. INTRODUCTION TO ASTROPHYSICS.
(3-0) Cr. 3. S.
Prerequisite: 345. Physical properties of stars and nebulae. Spectral classification and analysis. Stellar structure, evolution and the H-R diagram

354, 355. INTERMEDIATE MECHANICS.
(3-0) Cr. 3 each. W.S.
Prerequisite: 223, Math. 213. Newtonian mechanics, dynamic of particles, systems of particles, and rigid bodies. Lagrange's equations

361, 362. CLASSICAL MECHANICS.
(3-0) Cr. 3 each. F.W.
Prerequisite: 233, Math. 213. For physics majors in the accelerated program only. Newtonian mechanics, 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

371H, 372H, 373H. IDEAS OF PHYSICS.
(3-0) Cr. 3 each. Yr.
Prerequisite: Enrollment in the University Honors program or permission of instructor. 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 revolution in physics from 1900 to 1930—relativity, quantum theory and atomic structure. Nuclear physics 373 Current physics—nuclei, fundamental particles, solid state, low temperature

394. ELECTRONIC CIRCUITS.
(3-0) Cr. 3. F.
Prerequisite: 223, Math. 213. Analysis of electronic circuits used in experimental physics. Steady state and transient analysis of passive and active networks with introduction to Laplace transform techniques as applied to circuits. Stability of electronic feedback systems

411. SENIOR RESEARCH LABORATORY.
(0-6) Cr. 3 each time elected. 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

421, 422, 423. INTERMEDIATE MODERN PHYSICS.
(3-0) Cr. 3 each. Yr.

450. UNDERGRADUATE RESEARCH.
Cr. 1 to 6 each time elected. W.F.S.S.
Prerequisite: Permission of instructor. Experimental or theoretical research under staff supervision

481. QUANTUM MECHANICS AND ATOMIC PHYSICS.
(3-0) Cr. 3. W.
Prerequisite: 481. Introduction to statistical mechanics and to the transport properties, magnetic properties and the band theory of solids

483. NUCLEAR AND ELEMENTARY PARTICLE PHYSICS.
(3-0) Cr. 3. S.
Prerequisite: 482. Interaction of radiation with matter. Emission and detection of alpha, beta, gamma rays. Systematics and structure of nuclei. Models of nuclei. Nuclear reactions. Introduction to elementary particles

489. TUTORIAL SEMINAR.
(1-0) Cr. 1 each time elected. F.W.S.
Prerequisite: Permission of instructor. For junior and senior physics majors in the accelerated program. Topics of interest in physics discussed in small groups. Offered on pass-fail basis only

490. SPECIAL TOPICS.
Cr. 1 to 4 each time elected. W.F.S.S.
Prerequisite: Permission of instructor

494, 495, ELECTRICITY AND MAGNETISM.
(3-0) Cr. 3 each. F.W.
Prerequisite: 223, Math. 322, 410. 494: Electrostatics, magnetostatics, potential theory. 495: Maxwell's equations, dynamic fields, generation and propagation of electromagnetic waves in dielectric and conducting media

496. OPTICS.
(3-0) Cr. 3. S.
Prerequisite: 495. Dipole radiation, Fraunhofer diffraction, Kirchhoff integral, Fresnel diffraction, absorption, scattering and polarization, Zeeman effect, stimulated emission

499. SEMINAR.
(1-0) Cr. 1. F.W.S.
Required of all physics seniors. Topics in current research reported and discussed by members of the class
COURSES FOR GRADUATE STUDENTS, major or minor

Prerequisite: 304; 423 or 483.

504, 505. STELLAR ATMOSPHERES. (3-0) Cr. 3 each. 504: Alt. F. Offered 1969; 505: Alt. W. Offered 1970.
Prerequisite: 304; 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 1970.
Prerequisite: 304; 423 or 483.
Theory of physical processes in the interstellar medium: interstellar grains, galactic radio emissions, magnetic fields and synchrotron radiation. Dilute radiation fields, gaseous nebulae, planetary nebulae, evolutionary role of interstellar matter.

511, 512, 513. SOLID STATE PHYSICS. (3-0) Cr. 3 each. Yr.
Prerequisite: Credit or classification in 591, 592, 593.

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: 423 or 483.
Theory of nuclear reactions, alpha, beta and gamma radioactivity; nuclei; nuclear models. Interaction of charged particles with matter.

531, 532. THERMODYNAMICS, STATISTICAL MECHANICS AND KINETIC THEORY. (4-0) Cr. 4 each. F.W.
Prerequisite: 304, Math. 410.
The laws of thermodynamics; thermodynamic functions; applications to various systems; phase equilibria; principles of statistical mechanics; the microcanonical, canonical and grand canonical ensembles of classical and quantum mechanics and their application to physical problems; kinetic theory and equation of state of gases, transport theory, Boltzmann transport equations, Brownian motion and noise.

534. EXPERIMENTAL TECHNIQUES IN HIGH ENERGY PHYSICS.

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 bandstructure 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.

537, 538, 539. HIGH ENERGY PHYSICS. (3-0) Cr. 3 each. Yr.
Prerequisite: Permission of instructor. Bubble chamber techniques, design and use of beam transport systems, characteristics of present and planned accelerators, spark chamber and counter techniques.

547, 548, 549. MODERN PHYSICS. (3-0) Cr. 3 each. Yr.
Prerequisite: 221, 222, 223, Math. 322.
For graduate students not majoring in physics. 547: Hamiltonian formulation of classical mechanics; Maxwell's equations; the Schroedinger equation. 548: Application of the Schroedinger equation to the hydrogen atom, the H atom, the helium atom, and electrons in a periodic lattice; semiclassical theory of absorption and emission. 549: Nuclear physics, relativistic energy, mass, momentum relations; nuclear masses and binding energies; alpha, beta and gamma radioactivity; interaction of nuclear radiation with matter; nuclear reactions.

564. ADVANCED CLASSICAL MECHANICS. (4-0) Cr. 4. S.
Prerequisite: 355 or 362, 591, 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.
Electrostatics, magnetostatics, boundary value problems, Maxwell's equations, electromagnetic waves in isotropic and anisotropic media, diffusion, cavities and wave guides, motion of charged particles, electromagnetic radiation produced by currents and by moving charges.

591, 592, 593. QUANTUM PHYSICS. (4-0) Cr. 4 each. Yr.
Prerequisite: 355 and 423, or 483.
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.

640. SPECIAL TOPICS.
F.W.S.
Prerequisite: Permission of Instructor.

650. ADVANCED SEMINAR.
(1-0) Cr. 1 each time elected. F.W.S.
Topics of current interest.
A. Nuclear Physics.
B. Solid State Physics.
C. Astrophysics.
D. High Energy Physics.

660. ADVANCED TOPICS IN PHYSICS.
Cr. 1 to 3 each time elected. F.W.S.
Courses on advanced topics and recent developments.
A. Nuclear Physics.
B. Solid State Physics.

674, 675, 676. APPLICATION OF GROUP THEORY TO PHYSICS.
(3-0) Cr. 3 each. Alt. Yrs. Offered 1970-1971.
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.
681: Many-body theory, including second quantization techniques, Hartree-Fock, Bogolyubov, Brueckner, and other approximation methods. 682: Relativistic quantum mechanics, including Dirac theory of electrons, covariance and conservation laws, theory of quantized fields, interaction between fundamental particles and quantum electrodynamics. 683: S-matrix theory, including dispersion relations, complex angular momentum, and solution of scattering problems using unitary and analytic properties.

690. RESEARCH.
F.W.S.SS.

PLANT PATHOLOGY

For description of courses, see Botany and Plant Pathology.

POLITICAL SCIENCE

Professors: Donald E. Boles, Ph.D.; Herbert C. Cook, Ph.D.; Donald F. Hadwiger, Ph.D.; W. Robert Parks, Ph.D.; Ross B. Talbot, Ph.D.; Barbara J. Teters, Ph.D.

Associate Professors: V. Alton Moody, Ph.D.; Rolf H. W. Theen, Ph.D.; Charles W. Wiggins, Ph.D.

Assistant Professors: James L. Hutter, Ph.D.; Victor A. Olorunsola, Ph.D.; Robert I. Wessel, M.S.

Instructors: Abel Jacob, M.A.; A.J. Shakeshaft, M.A.

Undergraduate Study

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 disciplines, such as economics, history, psychology, sociology—anthropology, and statistics, as well as in the various areas of the humanities.

Students majoring in political science may substitute a second major in international relations for the two minors required in the College of Sciences and Humanities. See International Relations.

A pre-law undergraduate program may be pursued through a major in political science. For a more complete statement, see Pre-professional Study.

Graduate Study

The department offers major work for the degree Master of Arts 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.

It is anticipated that each student entering the Master of Arts program in political science will have completed one year of a foreign language (equivalent of 9 quarter hours) and a course in basic statistics (equivalent of Stat. 201). 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 the Stat. 401 course (preferably that section for political scientists). Stat. 402 (preferably that section for political scientists) is recommended also, but not required. It is permissible to substitute Stat. 401 and 402 for Stat. 201 and 401, although to do so a student should endeavor to audit 201 first.

These requirements are to be only the basic minimum. The Program of Study committee will decide if additional work, in either language or statistics, is necessary.


COURSES PRIMARILY FOR UNDERGRADUATE STUDENTS

215. AMERICAN GOVERNMENT. (3-0) Cr. 3. F.W.S.
Prerequisite: Engl. 105 or 132.
Fundamentals of democracy; nature of federalism, fundamentals of the Presidency, Congressional and Judicial process, the role of public opinion, interest groups and political parties in the governmental process.

230. BASIC ISSUES IN POLITICS. (3-0) Cr. 3. F.
Prerequisite: 215.
Basic issues in past and contemporary political systems, such as freedom, power, justice, security, general welfare, law and property.

241. COMPARATIVE POLITICAL SYSTEMS. (3-0) Cr. 3. F.W.S.
Prerequisite: 215.
Comparative examination of the political institutions of the major political systems of the world; institutions and political processes contrasted with those of the United States.

305. FUNCTIONS OF AMERICAN GOVERNMENT. (3-0) Cr. 3. F.W.S.
Prerequisite: 215.
Functions and problems of national, state and local governments, national security, foreign policy, governmental finance, regulation of business, labor and agriculture; science, education and welfare activities.

310. STATE AND LOCAL GOVERNMENT. (3-0) Cr. 3. S.
Prerequisite: 215; 305 recommended.
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 ADMINISTRATION. (3-0) Cr. 3. F.S.
Prerequisite: 215; 305 recommended.
Rise of city in American life, legal position of municipal corporation, forms of organization, personnel and fiscal administration; planning; streets and lights; police and fire administration; public health; recreation, water supply; sanitation, schools; public welfare administration; utility regulation.

320. AMERICAN JUDICIAL PROCESS. (3-0) Cr. 3. F.
Prerequisite: 215.
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.
Prerequisite: 215.
Survey of behavioral literature of political science; social and psychological bases of political behavior; major conceptual approaches to the study of political behavior; systems analysis, power groups, decision-making, communication, roles, and elites.

331. INTRODUCTION TO POLITICAL RESEARCH. (3-0) Cr. 3. W.
Prerequisite: 215; Stat. 201 recommended.
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.
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.

351. 352, 353. WORLD POLITICS AND INTERNATIONAL ORGANIZATION. (3-0) Cr. 3 each. Yr.
Prerequisite: 351; 353: 352.
351: Analysis of how traditional concepts of international relations have been altered by advent of nuclear weapons. Nuclear strategy, arms control, and international organizations.
360. CONGRESS AND THE STATE LEGISLATURES. (3-0) Cr. 3. F.
Prerequisite: 215.
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. F.
Prerequisite: 215.
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 and junior classification.
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 and junior classification.
American constitutional and statutory guarantees of civil rights. First Amendment rights of conscience and freedom of expression 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 and junior classification.
Development of the principles of international law of peace and war, analysis of theories concerning its nature and fundamental conceptions, 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: 6 credits in political science.
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: 6 credits in political science.
Major political philosophers from Bodin to Bentham.

432. DEVELOPMENT OF POLITICAL THOUGHT: 19th—20th CENTURIES. (3-0) Cr. 3. S.
Prerequisite: 430 or 431.
Major political philosophers and schools of thought, beginning with Marx and J. S Mill

433. AMERICAN POLITICAL THOUGHT. (3-0) Cr. 3. S.
Prerequisite: 241 or 305.
Analysis of major trends in the development of American political ideas, institutions, and theories.

440. BRITISH AND COMMONWEALTH GOVERNMENTS. (3-0) Cr. 3. F.
Prerequisite: 241.
Examination of the governmental processes, political parties and electoral systems of the United Kingdom and Dominion of Canada, Australia and New Zealand. Comparative treatment with the United States.

441. GOVERNMENTS OF WESTERN EUROPE. (3-0) Cr. 3. F.
Prerequisite: 241.
Comparative study of governments of France, Germany, and Italy. 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.
Comparative examination of governmental processes, political parties, electoral systems, political problems. Comparison with Western governments.

442B. GOVERNMENTS OF INDIA, PAKISTAN AND SOUTHEAST ASIA. (3-0) Cr. 3. S.
Prerequisite: 241.
Comparative examination of governmental processes, political parties, electoral systems, political problems. Comparison with Western governments.

443A. LATIN AMERICAN GOVERNMENTS. (3-0) Cr. 3. W.
Prerequisite: 241.
Political institutions and processes in the Latin American nations.

443B. RECENT LATIN AMERICAN POLITICS. (3-0) Cr. 3. S.
Prerequisite: 443A.
Analysis of selected, current political problems in Latin America.

444. GOVERNMENT AND POLITICS OF THE SOVIET UNION. (3-0) Cr. 3. W.
Prerequisite: 241.
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.

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: 241.
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: Hist. 251B.
Analysis of factors shaping objectives and politics of major Asian countries as participants in world politics.
458. UNITED STATES FOREIGN POLICY.  
(3-0) Cr. 3. F.  
Prerequisite: 215; 351 recommended.  
Elements of U.S. foreign policy, foreign-policy-making process; governmental and nongovernmental agencies and forces operating on the formation of foreign policy; trends and issues; national purposes; diplomacy; and impact of the Cold War.

464. POLITICAL PARTIES.  
(3-0) Cr. 3. F.  
Prerequisite: 305.  
Systems theory applied to political parties, concepts of group structure, party evolution, party supporters and leaders, voting behavior, party in government.

466. PUBLIC OPINION AND PRESSURE POLITICS.  
(3-0) Cr. 3. W.  
Prerequisite: 305.  
Public opinion measurement, political behavior, political socialization, power structure, group organization, lobbying.

471. PUBLIC ADMINISTRATION.  
(3-0) Cr. 3. F.  
Prerequisite: 305.  
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: 215; 305 recommended.  
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. F.  
Prerequisite: 215; 305 recommended.  
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: 215; 305 recommended.  
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: 215; 305 recommended.  
The political impact on selected policy development in certain Federal organizations: NASA, AEC, HEW, Commerce and NSF.

476. ADMINISTRATIVE LAW.  
(3-0) Cr. 3. S.  
Prerequisite: 215 and junior classification.  
Constitutional problems of delegation of governmental powers, elements of fair administrative procedures, judicial control over administrative determinations.

481A. DEVELOPMENT OF THE UNITED STATES CONSTITUTION TO 1865.  
(Hist. 481A) See History.

481B. DEVELOPMENT OF THE UNITED STATES CONSTITUTION SINCE 1865.  
(Hist. 481B) See History.

495. SPECIAL PROBLEMS.  
Cr. 2 to 5. F.W.S.  
Special studies in the political institutions, processes and policies of American, foreign, and international governments. Also, studies in traditional and behavioral political theory.

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 RURAL 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 rural governmental functions such as education, welfare, highways, including problems of taxation and finance. Effects of population shifts on future of rural governments.

512. GOVERNMENTS OF URBAN, REGIONAL, AND METROPOLITAN AREAS.  
(3-0) Cr. 3. W.  
Prerequisite: 311.  
Analysis of emerging political forces and changing governmental institutions in the urban, regional and metropolitan areas of the U.S.

520. PUBLIC LAW AND PUBLIC POLICY.  
(3-0) Cr. 3. S.  
Prerequisite: 420. Boles.  

530. ADVANCED POLITICAL THOUGHT.  
(3-0) Cr. 3. S.  
Prerequisite: 6 credits in courses numbered 430 through 433. Shakeshaft.  
Intensive study of one or more of the traditional political philosophers.

531A. RESEARCH METHODS IN POLITICAL SCIENCE.  
(3-0) Cr. 3. F.  
Prerequisite: 331. Hutter.  
Survey research, aggregate data collection, case studies, machine storage and statistical analysis of data.

531B. RESEARCH METHODS IN POLITICAL SCIENCE.  
(3-0) Cr. 3. W.  
Prerequisite: 331. Hutter.  
Games, simulations, voting studies, legislative data, judicial data, scale construction, questionnaire design, research design, historical data, the reputational method.

532A. BEHAVIORAL POLITICAL THEORY.  
(3-0) Cr. 3. W.  
Prerequisite: 330.  
Systems 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.
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 1970.
Prerequisite: 442A, Hist. 341. Teters.
Japanese theories of the state and government Development of Japanese political institutions Particular attention to period since 1945

544. RUSSIAN POLITICAL THOUGHT AND INSTITUTIONS.
(3-0) Cr. 3. S.
Prerequisite: 444. 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. S.
Prerequisite: 444, or 9 credits in political science. 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. Alt. S. offered 1970.
Prerequisites: three of the following courses: 351, 352, 353, 451, 556. Jacob.
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

COURSES FOR GRADUATE STUDENTS, major or minor

610. GRADUATE SEMINARS IN POLITICAL SCIENCE.
(3-0) Cr. 3 for each seminar.
Prerequisite: 15 credits in graduate courses in political science.
A American Political Institutions
B Public Law
C Political Theory and Methodology
D Comparative Politics
E International Relations
F Policy Process
G Public Administration and Public Policy

695. RESEARCH IN GOVERNMENT.

POULTRY SCIENCE
William W. Marion, Ph.D., Chairman of Department

Professors: Stanley L. Balloun, Ph.D.; Leonard Z. Eggleton, M.S.; Chester D. Lee, D.V.M., M.S.; Arne W. Nordskog, Ph.D.

Associate Professor: William J. Owings, Ph.D.

Assistant Professor: Donald L. Miller, Ph.D.

Undergraduate Study

For undergraduate curriculum in poultry science leading to the degree Bachelor of Science, see College of Agriculture, Curricula.

Educational opportunities in the Department of Poultry Science include broad training in all phases of the poultry industry which relate to the production, processing, storage and
distribution of poultry and egg products. Courses offered by the Department of Poultry Science include instruction in hatchery and poultry farm management and administration, poultry nutrition, housing, incubation, breeding, processing and marketing, and courses in the management phases associated with meat and egg production.

The poultry science curriculum also includes course work in the social and basic sciences in order to provide the graduating student with a satisfactory background which will qualify him for entry into either specialized commercial fields of work or advanced academic study. Elective courses are permitted in the curriculum in order that consultation with the department staff, other fields of study of special interest to them.

Poultry graduates are employed in a wide variety of different areas. These areas include employment by hatcheries, specialized poultry farms (including breeding farms), feed manufacturing organizations, poultry and egg processing plants, poultry equipment and supply companies, publishers, and as poultry specialists by state and federal agencies for employment both in continental United States and overseas areas.

Graduate Study

Major work for the degrees Master of Science and Doctor of Philosophy is offered by the Poultry Science Department in the fields of nutrition, breeding, physiology and poultry products technology. Courses are offered in other departments for minor work in specialized fields to supplement the major field of study.

A strong undergraduate program is required of those students interested in undertaking graduate study in this department. Fundamental training in biology, chemistry, mathematics, statistics and other related fields is a prerequisite to a satisfactory graduate program.

Open to graduate students for minor only: 401, 402, 403, 404.

COURSES PRIMARILY FOR UNDERGRADUATE STUDENTS

110. TECHNICAL LECTURE.  
(1-0) Cr. R.F.  
Opportunities in poultry science

114. ANIMAL PRODUCTION.  
(An. S. 114) See Animal Science.

301. POULTRY SCIENCE TECHNIQUES.  
(1-3) Cr. 2. F.  
Prerequisite: 114 or 365.  
A laboratory course designed to supplement 114 or 365. Selection of breeding and laying stock, grading of eggs, pre-mortem and post-mortem grading of poultry, study of internal organs and their functions. Trips to nearby poultry farms.

302. INCUBATION AND HATCHERY MANAGEMENT.  
(2-2) Cr. 3. Alt. S. Offered 1971.  
Prerequisite: 114.  
Problems in hatchery management, including the principles of artificial incubation. Trips to nearby hatcheries.

305. POULTRY SEMINAR.  
(1-0) Cr. 1 each time taken. W.

365. POULTRY FEEDING AND MANAGEMENT.  
(3-0) Cr. 3. W.S.S.S.  
Prerequisite: Junior or senior classification or Pre-Vet.  
Practical feeding and management of poultry flocks. Operational study of commercial poultry farms, including production and marketing practices.

367. POULTRY MORTALITY STUDIES.  
(1-0) Cr. 2.  
Prerequisite: 365.  
An introduction to poultry disease, disease diagnosis and control techniques.  
Practical study of poultry mortality problems including techniques for determining the cause of mortality, human relations and bacteriological techniques.  
Practical work in the Department's laboratory guidelines, and practical experience at chicken farms.

401. MEAT AND EGG TECHNOLOGY.  
(3-3) Cr. 4. F.  
Prerequisite: Bact. 304.  
Measurement of quality factors influencing disease, environment, genetics and nutrition on quality. Processing methods. Decline in product quality. Trips to nearby processing plants.

402. POULTRY BREEDING.  
(3-0) Cr. 3. Alt. S. Offered 1970.  
Prerequisite: Gen. 301.  
Inheritance of egg production, egg size, hatchability, body size, viability and plumage color, methods of poultry breeding.

403. TURKEY PRODUCTION.  
(2-3) Cr. 3. Alt. W. Offered 1971.  
Prerequisite: 114 or permission of instructor. Development of the turkey industry and the commercial production of hatching eggs, poult and mature stocks. Trips to nearby farms.

404. POULTRY NUTRITION.  
(3-2) Cr. 4. F.  
Prerequisite: An.S. 318.  
Practical aspects of poultry nutrition. Ration formulation, mixing and feeding tests. Feeding programs and requirements at different ages.

490. SPECIAL PROBLEMS.  
Cr. 1 to 3. Yr.  
Open to junior or senior students showing satisfactory preparation for problem chosen and quality point average of 2.5 or above for two preceding quarters. Conferences and preparation of report on individual problems.  
H Honors

COURSE PRIMARILY FOR GRADUATE STUDENTS, major or minor, open to qualified undergraduates

590. SPECIAL TOPICS.  
Cr. arr. F.W.S. SS.
Courses and Programs

Courses for Graduate Students, major or minor

601. ADVANCED POULTRY BREEDING.
(3-0) Cr. 3. Alt. S. Offered 1970.
Prerequisite: 402, Nordskog.
Survey of poultry genetics. Application of systems of breeding to poultry, including inbreeding, outbreeding, hybridization and methods of selection.

603. SEMINAR IN ANIMAL NUTRITION AND MEATS.
(An.S. 603) See Animal Science.

605. METHODS AND TECHNIQUES IN ANIMAL NUTRITION EXPERIMENTATION.

614. ADVANCED POULTRY NUTRITION.
(2-2) Cr. 3. Alt. S. Offered 1970.
Prerequisite: Permission of instructor. Balloun. Requirements, interaction and metabolism of nutrients by chickens and turkeys. Development and testing experimental diets, including deficiency studies.

680. MODERN VIEWS OF NUTRITION.

690. RESEARCH.
A. Poultry Breeding. Nordskog.
C. Avian Physiology Marion.
D. Poultry Products Technology Marion.

Pre-Professional Study at Iowa State University

Requirements for admission to most professional academic programs can be met by study at Iowa State University. Pre-professional programs vary from one year to four years. In some programs requiring three years of pre-professional 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 Pre-professional and Baccalaureate Degree 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 pre-professional 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 pre-professional programs will be furnished, upon request, by the Dean, College of Sciences and Humanities.

Combination Pre-professional and Baccalaureate Degree 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 pre-professional requirements oriented toward a more liberal education, pre-dentistry 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 pre-professional 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 Veterinary Medicine: Although most schools of veterinary medicine require two years of pre-professional 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 bachelor's degree from Iowa State University upon completion of the first year of study in a school of veterinary medicine. For additional information see Index, Veterinary Medicine.
Four-Year Pre-professional Programs

Preparation for the Study of Human Medicine: Most medical schools recommend a pre-professional 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 and the humanities. To obtain this background, students should elect four years of pre-professional study leading to the bachelor's degree. A less desirable choice includes three years of pre-professional study and one year of professional education at a medical school (including approved schools of osteopathy), the total of four years leading to the bachelor's degree 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 pre-law 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 Pre-professional Programs

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. Pre-professional education should include strong backgrounds in the natural sciences, social sciences, and humanities leading to the bachelor's degree before commencing professional study.

Preparation for the Study of Occupational Therapy: Occupational therapists working under the supervision of a physician assist patients in recovery and rehabilitation by the use of creative, educational, and recreational activities. Iowa State University offers two years of pre-professional study in the sciences and humanities to serve as an educational background for completing the professional program at some other institution.

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 pre-professional 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 three sciences 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 the three sciences a full undergraduate program leading to the bachelor's degree.

PSYCHOLOGY
A. C. MacKinney, Ph.D., Head of Department


Instructor: Harold Gelfand, B.A.
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. Undergraduate majors frequently are employed as employment interviewers, psychometricians and personnel technicians.

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.

Several undergraduate courses provide students with the opportunity to gain first-hand experience with psychological research through participation as subjects in experimentation directed by faculty members. In some courses, particularly 101, such experience is deemed important enough to warrant requiring every student to participate. In other courses opportunities are made available to students to volunteer for research participation.

Graduate Study

The department offers major work for the degrees Master of Science and Doctor of Philosophy in certain fields of psychology, and minor work to students taking major work in other departments.

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.

COURSES PRIMARILY FOR UNDERGRADUATE STUDENTS

10. ACADEMIC LEARNING SKILLS. (2-2) 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.

201. LEARNING AND MOTIVATION. (3-0) Cr. 3. F.W.S.S. Prerequisite: 101. Fundamental concepts and principles of learning and motivation. Data from human and animal experimentation considered.

202. SENSATION AND PERCEPTION. (3-0) Cr. 3. F.W.S.S. Prerequisite: 101. An appraisal of traditional and contemporary psychophysical models. A study of the general characteristics of the senses and the basic conditions and principles of human perception with an emphasis on vision.

230. DEVELOPMENTAL PSYCHOLOGY. (3-0) Cr. 3. F.W.S.S. Prerequisite: 101. Characteristic 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. W. Prerequisite: 101. The application of psychological principles in marketing to include selling, advertising, packaging, and sales promotion; introduction to consumer surveys and motivational research techniques

301, 302. EXPERIMENTAL PSYCHOLOGY. (1-4) Cr. 3 each. F.W.S. Prerequisite: 301: 201 and Stat. 201; 302: 202 and Stat. 201. Research methodology in psychology. The scientific study of human behavior emphasized in psychophysics, perception, sensory processes, motivation and learning. Research techniques applied in laboratory setting. Need not be taken in sequence.
305. PHYSIOLOGICAL PSYCHOLOGY. (2-2) Cr. 3. S.
Prerequisite: 201 or 202 and Zool. 155.
Neurophysiological correlates and systems underlying behavior. Physiological processes underlying sensori-motor activity, motivation, and learning.

333. EDUCATIONAL PSYCHOLOGY. (2-2) Cr. 3. F.W.S.S.S.
Prerequisite: 230.
Study of human learning, with particular attention to applications in the classroom. Includes laboratory experience in the use of standardized school tests and practice in devising teacher-made tests. Honors section Emphasis on original research literature and individual projects. For students in the University Honors Program only.

380, 381. SOCIAL PSYCHOLOGY. (3-0) Cr. 3. F.W.
Prerequisite: 380: 101 or junior standing; 381: 380.
380: Motives in interpersonal relationships, development of attitudes, suggestibility and persuasibility, obedience, imitation, leadership and power, cooperation and competition. 381: Social influence, conformity and deviation, social dependence, people as sources of information, cognitive theories.

401. HISTORY AND SYSTEMS IN PSYCHOLOGY. (3-0) Cr. 3. S.
Prerequisite: 12 credits in psychology. The philosophical and theoretical antecedents of contemporary psychology.

430. PSYCHOLOGY OF ADOLESCENCE. (3-0) Cr. 3. F.W.S.S.S.
Prerequisite: 230.
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. W.S.S.S.
Prerequisite: 230 or C.D. 336.
Emotional and behavioral characteristics of atypical children. Characteristics of gifted children; educational and psychological problems in physical, neural, sensory and intellectual deficiency. Clinical observation and work with handicapped available.

440. PSYCHOLOGICAL MEASUREMENT I. (3-0) Cr. 3. F.W.S.S.S.
Prerequisite: 6 credits in psychology. Stat. 201.
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.

COURSES PRIMARILY FOR GRADUATE STUDENTS, major or minor, open to qualified undergraduates

Prerequisite: 201, 202; Stat. 201. Schuster.
Contributions of psychology to the consideration of human factors in engineering design. Human sensory-motor characteristics important to design of man-machine systems.

501, 502, 503, 504. ADVANCED EXPERIMENTAL PSYCHOLOGY. (2-2) Cr. 3 each. 501: F; 502, 503: W; 504: S.
Theory and techniques of psychological scaling, with emphasis on attitude scaling. Unidimensional approaches of Thurstone, Likert, Guttman. Introduction to multidimensional model.

450. INDUSTRIAL PSYCHOLOGY I. (3-0) Cr. 3. F.S.S.
Prerequisite: 101 or junior standing.
Content and methods of industrial psychology: selection techniques, merit rating, employee counseling, attitudes and morale, training, leadership and job evaluation.

451. INDUSTRIAL PSYCHOLOGY II. (3-0) Cr. 3. W.
Prerequisite: 450.
Content and methods of industrial psychology with emphasis on industrial social psychology: employee motivation, morale, job satisfaction, leadership, communication, organization theory.

460. PSYCHOLOGY OF ADJUSTMENT. (4-0) Cr. 4. F.S.S.
Prerequisite: 9 credits in psychology.
Normal and abnormal modes of adjustment. Emphasis on motivation and learning in development of adjustment patterns.

490. SEMINAR IN PSYCHOLOGY. (1 to 3-0) Cr. 1 to 3 each time elected. Offered when demand warrants.
Prerequisite: permission of instructor.
Seminars on special topics in psychology.

490H. HONORS RESEARCH SEMINAR. (2-0) Cr. 1 each time elected. F.W.S.
Prerequisite: permission of instructor.
A discussion of selected contemporary research problems in psychology. Offered only on a pass-fail basis.

495. APPLIED PSYCHOLOGY. (3-0) Cr. 3. W.
Prerequisites: 440, 460.
Critical construction of fields of applied psychology, including current research and applications in fields such as clinical, counseling, and industrial psychology.

499. SPECIAL PROBLEMS. Cr. 1 to 4 each time elected. F.W.S.S.S.
Prerequisite: 6 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.
D. Developmental.
E. Experimental.
F. Educational and Learning.
G. Individual Differences and Psychometrics.
H. Honors.
I. Clinical and Abnormal.
J. Guidance, Personnel, Counseling.
K. Industrial—Organizational.
L. Exceptional Children.
M. School Psychology.
N. Social.
506. FACTOR ANALYSIS.

510. COMPARATIVE PSYCHOLOGY.
(3-0) Cr. 3. Alt. W. Offered 1971.
Prerequisite: 301 or 305. Karas.
Concepts and techniques used in the experimental analysis of animal behavior. Emphasis on mammalian behavior.

515. ADVANCED PHYSIOLOGICAL PSYCHOLOGY.
(3-0) Cr. 3. F.S.
Prerequisite: Zool. 224 and 355, or V. Anat. 217 and V. Pharm. 264.
515: Neurophysiological correlates of behavior with emphasis on sensory-motor systems. 516: Neurophysiological correlates of behavior with emphasis on motivation and learning.

522. PSYCHOLOGY OF COUNSELING.
(3-0) Cr. 3. F.S.S.
Prerequisite: 15 credits in psychology including 440. Lewis.
Counseling procedures and techniques. Theory, research, and evaluation of counseling. Counseling as a profession.

523. VOCATIONAL PSYCHOLOGY.
(2-2) Cr. 3. W.
Prerequisite: 9 credits in psychology. Zytowski. 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. F.S.S.
Prerequisite: 15 hours (including 230 or C.D. 336) or graduate standing. Charles.
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. S. Offered 1970.
Prerequisite: 15 credits in psychology including 436. Charles.
Study of the 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 I.
(3-0) Cr. 3. Alt. W. Offered 1971. SS.
Prerequisite: 9 credits in psychology, including 333. Bath.
Educational applications of the principles of human growth and development, individual differences and learning. Evaluation of research pertinent to curriculum and instruction.

534. ADVANCED EDUCATIONAL PSYCHOLOGY II.
(3-0) Cr. 3. Alt. S. Offered 1971. SS.
Prerequisite: 501, 533. Brown.
The application of psychological principles and methodology to the 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 1971.
Prerequisite: 230, 333. Warman.
The 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: 9 credits in psychology, including 440. Walsh.
Theoretical and instrumental definition of variables. Theoretical and philosophical approaches to reliability and validity.

541. INDIVIDUAL MENTAL TESTING: ADULTS.
(0-6) Cr. 3. S.SS.
Prerequisite: 440, permission of instructor. Hanum.
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.
(0-6) 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 1970.
Prerequisite: 440 or permission of instructor. Mackney.

551. ORGANIZATIONAL PSYCHOLOGY.
(3-0) Cr. 3. Alt. W. Offered 1971.
Prerequisite: Psych. 451, 550. Lyons.
Methods, theory and practice of industrial-social psychology, with emphasis on behavioral research in industrial settings.

560. PSYCHOLOGY OF PERSONALITY.
560: (3-0) Cr. 3; 561: (3-0) Cr. 3; 562: (2-2) Cr. 4.
Prerequisite: 460 or graduate standing. Mills. 560: Personality theories. Major concepts, methods, and problems in the study of personality. Analysis of theories of personality, with emphasis on personality development in the normal population. 561: Psychopathology and behavioral deviations. Application of personality theory to the study of abnormal behavior. Analysis of the etiology and dynamics of various psychopathological entities, including the psychoneuroses and psychoses. 562: Personality assessment. Basic concepts underlying personality assessment. Objective and projective methods for the measurement of personality.

580. ADVANCED SOCIAL PSYCHOLOGY.
(3-0) Cr. 3. F.S.S.
Prerequisite: 9 credits in psychology including 380.
Theoretical approaches in contemporary social psychology. The impact of each of the following
on social psychology learning, ecological, Gestalt, cognitive, role, and field theories, mathematical and analog modeling, and instrumental (rational) interaction.

581. PSYCHOLOGY OF PERSUASION.   (3-0) Cr. 3. W.  
Prerequisite: 15 credits in psychology, including 380.  
Effects of persuasive communications on attitudes, beliefs, and behavior. The nature of attitudes, tactics of research design and measurement, and substantive findings from research on attitude change and social influence.

599. SPECIAL TOPICS.   
Cr. 1 to 4 each time elected.  F.W.S.S.S.  
Prerequisite: 12 credits in psychology, permission of instructor.

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. Charles.  
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. Bartz.  
Advanced experimental investigation and theory of cognitive processes including thinking, problem-solving, and conceptual behavior.

605. PSYCHOLOGY OF MOTIVATION.   (2-0) Cr. 2. F.  
Prerequisite: 503 or 504. Edwards.  
An examination of the major research findings and theoretical concepts in the psychology of motivation.

620. PSYCHOLOGICAL COUNSELING.   (3-0) Cr. 3. W.S.  
Prerequisite: 522. Warman.  
Advanced theory and practice in psychological counseling with emphasis on application of counseling and testing techniques, case studies and role playing.

636. SCHOOL PSYCHOLOGY.   (1 to 3-0) Cr. 1 to 3, F.W.S.  
Prerequisite: Enrollment in school psychology training program, permission of instructor. Bath, Charles.  
The practice of school psychology; examination of the duties, responsibilities, ethics and problems of the profession.

690. SEMINAR IN PSYCHOLOGY.   (1 to 3-0) Cr. 1 to 3 each time elected. Offered when demand warrants.  
Prerequisite: Graduate standing.  
A. Counseling.  
B. Educational-Developmental.  
C. General-Experimental.  
D. Industrial-Organizational.  
E. Psychometrics.

691. PRACTICUM IN PSYCHOLOGY.   (As Arranged) Cr. 1 to 4 each time elected.  F.W.S.S.S.  
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.

699. RESEARCH.

SOCIOLGY AND ANTHROPOLOGY

George M. Beal, Ph.D., Chairman of Department

Professors: Joe M. Bohlen, Ph.D.; Dwight G. Dean, Ph.D.; Dorothy Lee, Ph.D.; Walter A. Lunden, Ph.D.; Ronald C. Powers, Ph.D.; Margaret C. Warning, Ph.D.

Associate Professors: Harry Cohen, Ph.D.; David M. Gradwohl, Ph.D.; Gerald E. Klonglan, Ph.D.; Elmer W. Schwieder, Ph.D.; William H. Stacy, Ph.D.; Richard D. Warren, Ph.D.

Assistant Professors: Hei C. Chang, Ph.D.; Gary Granzberg, Ph.D.; Cherry C. Kinney, Ph.D.; Edward A. Powers, Ph.D.; Dean R. Yoesting, Ph.D.

Undergraduate Study

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 degree of 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

A major in sociology prepares a student for a variety of occupational fields, among which are (1) positions in private and public welfare, and group agencies; (2) civil service appointments with government agencies; (3) college and university teaching, research, and extension work; (4) positions with personnel departments in industry or farm organization. The facilities of the University provide unusual opportunities for apprenticeship in social welfare and for research in industrial relations, demography, family, ethnic and intergroup relations, community, and social problems.

Undergraduate students with majors in sociology usually include the following courses in their programs: 134, 135, 202, 301, 305, 401, 402, 445, or 330, and 18 additional upper level credits in sociology courses.

In addition to the basic courses for all majors in sociology, fields of specialization are represented by the following:

3. Industrial Sociology: 380, 410, 480, 486.

A minor in sociology is particularly suitable for students majoring in other social sciences or in technical and applied fields where principles and applications of group organization and group behavior are helpful.

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 an individual 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). Undergraduate students may obtain experience in archaeological and ethnological research.

Undergraduate students with majors in anthropology usually include the following courses in their programs: 218, 219, 220, 321, 421, 422, and 21 additional credits in anthropology courses. 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. Undergraduates majoring in sociology, and majors outside the department, may minor in anthropology.

The principal subdisciplines of anthropology are represented by the following:

2. Archaeology: 220, 420, 426, 428, 429, 499A.
5. Physical Anthropology: 219, 499C.
Sociology and Anthropology is a cooperating department in the curriculum in Public Service and Administration in Agriculture. The curriculum 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**

Qualified students are encouraged to pursue graduate study, since the more responsible positions require advanced degrees. The department offers major work for the degrees Master of Science and Doctor of Philosophy in sociology and rural sociology and minor work for students majoring in other departments. Students may concentrate in anthropology at the graduate level.

Prerequisite to major graduate work in the department is the completion of undergraduate work in economics, mathematics, statistics, sociology, anthropology, and other social science and technical subjects, substantially equivalent to that required of undergraduate students majoring in sociology or anthropology at this institution.

The department stipulates no minimum 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.*

*134. INTRODUCTION TO SOCIOLOGY. (3-0) Cr. 3. F.W.S.SSI.SSI. Analysis of the effects of group relations on human behavior; interrelations of personality, group, community and culture; major social processes, practical study of society.*

*135. SOCIAL PROBLEMS. (3-0) Cr. 3. F.W.S.SSI 1970. SSI 1971. Prerequisite: 134 or 200. Nature and meaning of social problems; incidence and characteristics of selected social problems of major public interest; analysis of proposed solutions.*

*200. RURAL INSTITUTIONS AND ORGANIZATIONS. (4-0) Cr. 4. F.W.S. Structure and problems of rural groups. Field trips to farmer meetings; visiting lecturers; discussions by agricultural leaders.*

202. SOCIOLOGICAL INQUIRY. (3-0) Cr. 3. F.W.S.SSI. Prerequisite: 134 or 200. Focus on scientific and non-scientific character of sociology as well as the logical peculiarities of social inquiry. Examination of nature and function of concept formation, rules of theory building and verification. Analysis of relationship between normative and empirical theory.

300. RACE AND MINORITY GROUP RELATIONS. (3-0) Cr. 3. F.W.S. Prerequisite: 134 or 200 or Anthro. 218. Minority groups and social structure; analysis of causes and consequences of group conflict with emphasis upon prejudice and discrimination in the United States.

301. PRINCIPLES OF SOCIOLOGY. (3-0) Cr. 3. F.W.S.SSI. Prerequisite: 202. Introduction to advanced principles; analysis of concepts and propositions.
305. SOCIAL INTERACTION.
(3-0) Cr. 3. F.W.S. SSI.
Prerequisite: 202.
Dynamics of social relations; analysis of human behavior in group situations.

319. COURTSHIP AND MARRIAGE.
(3-0) Cr. 3. F.W.S.SSI 1970. SSI 1971.
Prerequisite: Sophomore standing.
A person-centered analysis of courtship and marriage relationships; contributions of the various fields of knowledge to the understanding of courtship and marital adjustment.

330. SOCIAL STRATIFICATION.
Prerequisite: 134.
Social status and social class; analysis of stratification systems in the United States; social status and behavior differences; social mobility.

335. CRIMINOLOGY.
(2-0) Cr. 3. F.W.S.
Prerequisite: 134.
Extent and character of crime in rural and urban areas; treatment and care of offenders; programs for prevention. Field trips and interviews with public officials.

336. JUVENILE DELINQUENCY.
(3-0) Cr. 3. F.W.S.
Prerequisite: 134.
Sociological nature and extent of delinquency; administration of juvenile courts; institutional treatment; probation and parole. Field trips and interviews.

364. GROUP DYNAMICS.
(2-3) Cr. 3. F.W.S.
Prerequisite: 134 or 200.
Planning and conducting group activities; relation of group dynamics and group techniques to group productivity; laboratory, group analysis, field practices.

380. SOCIAL RELATIONS IN INDUSTRY.
(3-0) Cr. 3. F.W.S.
Prerequisite: 6 credits in sociology or anthropology.
Formal and informal group aspects of business and industrial organizations; group aspects of personnel administration and worker adjustment

*382. SOCIOLOGY OF AGRICULTURAL MARKETING FIRMS.
(3-0) Cr. 3. F.
Prerequisites: 134 or 200, Psych. 101, Econ. 241.
Sociological analysis of merchandising, marketing and management in local retail agricultural supply and marketing firms. Internal analysis of retail firms, their relation to the distribution system and to consumers.

*390. SOCIOLOGY OF RURAL LIFE.
(3-0) Cr. 3. F.
Prerequisite: 134 or 200.
Changing characteristics of rural society; human relationships, values, institutions affected by changing population, technology and agricultural practices.

*391. RURAL SOCIETY ADJUSTMENT.
(3-0) Cr. 3. F.
Prerequisite: 134 or 200.
Contemporary changes in rural society including demographic, social institutions and organizations, and values. Adequacy of existing institutions, organizations, and agencies to meet needs of rural people. Alternative structures and strategies to meet changing needs.

*392. ADOPTION AND DIFFUSION OF INNOVATIONS.
(3-0) Cr. 3. W.
Prerequisite: 134 or 200.
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.

*393. SOCIOLOGICAL ANALYSIS OF AGRICULTURE RELATED AGENCIES.
(3-0) Cr. 3. S.
Prerequisite: 134 or 200.
Agriculture agencies studied as a social system and bureaucracy; creation of agencies, internal operations of agencies, linkage of agencies to farmer or general public.

401. CONTEMPORARY THEORIES.
(3-0) Cr. 3. W.S. SSI.
Prerequisite: 301.
Analysis of major contemporary sociological theories.

402. RESEARCH METHODS IN SOCIOLOGY.
(3-0) Cr. 3. F.W.S.SSI.
Prerequisite: 301.
Research design, field procedures and analysis of data.

410. SOCIOLOGY OF CITY LIFE.
(3-0) Cr. 3. F.G.S.SSI 1970. SSI 1971.
Prerequisite: 134.
Growth, structure, and functions of the city; urban-social relations.

437. CORRECTIONAL INSTITUTIONS.
(3-0) Cr. 3. S.
Prerequisite: 335 or 336.
Analysis of organization and administration of correctional institutions. One-week field trip to an assigned institution.

438. PROBATION AND PAROLE.
(3-0) Cr. 3. W.
Prerequisite: 335 or 336.
The organization and administration of systems of after-care treatment of juvenile and adult offenders released by the courts under probation and from correctional institutions on parole

445. POPULATION STUDIES.
(3-0) Cr. 3. F.W. SSI 1970. SSI 1971.
Prerequisite: 134 or 200.
Composition and characteristics of changing population; birth rates, and mobility; introduction to population theory and policy.

450. HUMAN ECOLOGY.
(3-0) Cr. 3. F.
Prerequisite: 134.
Relationships among people growing out of their relationship to their natural and cultural environments.

454. FIELD OBSERVATION AND PRACTICE.
Cr. 1 to 3 each time taken. F.W.S.
Prerequisite: 9 credits in sociology.
Supervised practice in established organizations and agencies.
A. Rural organizations and group work agencies.
B. Industrial plants and related organizations.
C. Welfare and professional group work agencies.
1) Family life education and agencies.

460. OBSERVATION AND PRACTICE IN CORRECTIONAL WORK.
Cr. 1 to 5 each time taken. W.S.
Prerequisite: 437.
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 WELFARE.
(3-0) Cr. 3. F.
Prerequisite: 9 credits in sociology.
Survey of the fields of social welfare and social work; welfare programs and agencies.
462. INTRODUCTION TO SOCIAL CASEWORK. (3-0) Cr. 3. W.
Prerequisite: 461.
Principles, concepts, and methods of social casework and their application in agencies and institutions

463A, 463B. SOCIAL WORK FIELD PLACEMENT. Cr. 5 each. 463A: W; 463B: S.
Prerequisites: 463A: Concurrent registration in 462, consent of instructor; 463B: 463A.
Field placement in selected welfare agencies under professional supervision. It is strongly recommended that students taking 463A take 463B as well.

464. COMMUNITY ACTION. (3-0) Cr. 3. W.S.SSI.
Prerequisite: 202.
Community analysis of mobilization and organization of community resources for social action, field studies

471. SOCIOLOGY OF EDUCATION. (3-0) Cr. 3. W.
Prerequisites: 134 or 200. Educ. 204 for education major.
Analysis of school-community relationships; examination of the intra-system relationships within the school.

473. SOCIOLOGY OF YOUTH. (3-0) Cr. 3. S.
Prerequisite: 134 or 200.
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: 202 or 380.
Social organization of industrial systems, social implications of bureaucracy and technological change.

483. SOCIOLOGY OF LEISURE AND RECREATION. (3-0) Cr. 3. W.

COURSES PRIMARILY FOR GRADUATE STUDENTS, major or minor, open to qualified undergraduates
COURSES IN SOCIOLOGY

500. HISTORY OF SOCIOLOGICAL THOUGHT. (4-0) Cr. 4. F.
Prerequisite: 9 credits in sociology.
Origin and development of sociological thought from earliest times to the twentieth century

501, 502. ADVANCED SYSTEMATIC THEORY. (4-0) Cr. 3 each. W.S.
Prerequisite: 500.

503. INTERMEDIATE SOCIOLOGICAL INQUIRY AND THEORY. (3-0) Cr. 3. F.
Prerequisite: 401.
Science and sociology. Units of sociological analysis. Taxonomies in sociology; concepts, subconcepts, levels of concepts. Elements of systematic sociological theory, propositions, explanation, prediction, cause. Use of sociological theory in research.

505. PRIMARY RELATIONS. (3-0) Cr. 3. Alt. W. Offered 1970.
Prerequisite: 202, 305 or Psych. 380.
Analytic treatment of diffuse, affective interpersonal relations, development of such primary

Prerequisite: 134 or 200.
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. SSII.
Prerequisite: 134.
Analysis of the family as a group; cultural influences, group processes and institutional aspects.

Prerequisite: 202 or 305.
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.

488. FAMILY LEGISLATION. (3-0) Cr. 3. S.
Prerequisite: 6 credits in sociology.
Analysis of welfare legislation relating to marriage, guardianship, adoption, divorce, and dependents; legal status of husband, wife, and children. Laws relative to social security.

499. SPECIAL PROBLEMS. Cr. 1 to 5 each time taken. F.W.S.
Prerequisite: 9 credits in sociology.
A General Sociology.
* B Rural Sociology.
C Social Welfare.
D Industrial Sociology.
E Family Sociology
H Honors.

*Offered by the College of Agriculture. Courses not marked by an asterisk are offered by the College of Sciences and Humanities.

511. INTERMEDIATE RESEARCH METHODS IN SOCIOLOGY. (3-0) Cr. 3. F.
Prerequisite: 502.
Sociological research methods. Kinds of inferences to be made from survey data and experimental data. Evaluation of current literature.

570. SOCIAL ORDER AND SOCIAL CONFLICT. (Pol.S. 570) (3-0) Cr. 3. W.
Prerequisite: 9 credits in sociology, 9 credits in political science or history.
Sociological analysis of power, power structure, mass society, and elite formation; conflict management within and between nations.

585. SOCIAL CHANGE AND THE FAMILY. (3-0) Cr. 3. S.
Prerequisite: 485.
Analysis of the interrelationships of the family institution and social change; industrialization, urbanization, modernization, mobility. Functions of the family in a modern and changing society.
590. SOCIAL ORGANIZATION.
(3-0) Cr. 3. Alt. W. Offered 1971.
Prerequisite: 502.
Theories of social organization; group structure
and process as frames of reference. Differenti­
tiating factors affecting the structure of society;
classification of basic social forms.

599. SPECIAL TOPICS.
Cr. 1 to 5 F.W.S.SSI.SSII.
Prerequisite: 15 credits in sociology, senior or
graduate classification.
A. General Sociology.
B. Social Welfare.
C. Industrial Sociology.
D. Family Sociology.
E. R. Rural Sociology

COURSES FOR GRADUATE STUDENTS, major or
minor
Courses in Sociology

600. 601. ADVANCED THEORETICAL ANALYSIS.
(3-0) Cr. 3. W.S.
Prerequisite: 502.
Contemporary theory construction in sociology;
concept formation; models in sociology; stages
in the development of sociological theory. Formal
strategies to theory construction. Philosophical
and theoretical bases of sociology. Historical
antecedents of contemporary sociological theories.
Comparison of various schools in sociology.

601. SOCIOLOGICAL MEASUREMENT.
(3-0) Cr. 3. Alt. W. Offered 1970.
Prerequisites: 502, 511.
The notion of causality in sociology; cause in
social theory; causal in social methods; contem­
porary approaches to causal analysis.

613. CAUSAL MODELS IN SOCIOLOGY.
(3-0) Cr. 3. Alt. S. Offered 1971.
Prerequisites: 502, Stat. 401.
The notion of causality in sociology; cause in
social theory; cause in social methods; contem­
porary approaches to causal analysis.

698 ADVANCED TOPICS IN SOCIOLOGY.
(3-0) Cr. 3 each.
A Social Theory. F

D. Social Interaction and Communication. Alt
S. Offered 1970.
F. Social Change and Social Control. Alt. W
Offered 1971.
G. Demography and Ecology. Alt. S. Offered
1970.
H. Research Methods W
L. Current Emphases in Marriage and the Fam­
ilv. F
M. Research in Marriage and Family. S
*N Rural Community Organization. Alt. F. Of­
ered 1970
*O. Bureaucracies in Rural Society. Alt. W. Of­
ered 1970.
*P. Current Rural Research F W.S
*Q. Application of Theory to Rural Sociology
Alt. S Offered 1971
*R Development of Rural Research. Alt. W Of­
ered 1970.

699. RESEARCH.
* A Rural Sociology.
B. General Sociology

*Offered by the College of Agriculture. Sociology
courses not marked by an asterisk are offered by
the College of Sciences and Humanities.

COURSES PRIMARILY FOR UNDERGRADUATE STUDENTS
Courses in Anthropology

218. INTRODUCTION TO CULTURAL
ANTHROPOLOGY.
(3-0) Cr. 3. F.W.S.SSI. 1970. SSI 1971.
Anthropological concepts and techniques for un­
derstanding world cultural similarities and dif­
fences; universal aspects of human experience,
including the family, economic, political, and
religious systems examined in cross-cultural per­
spective.

219. INTRODUCTION TO PHYSICAL
ANTHROPOLOGY.
(3-0) Cr. 3. W.
Human origins, fossil man, differentiation into
races; physical anthropology of the living; in­
terplay of biological and cultural factors in hu­
mam evolution.

220. INTRODUCTION TO ARCHAEOLOGY.
(3-0) Cr. 3. F.
Origin and development of culture from Pale­
olithic assemblages through the beginnings of
civilization, world prehistory by major culture
areas.

321. COMPARATIVE STUDIES OF WORLD
CULTURES.
(3-0) Cr. 3. B.
A comparative survey of cultural patterns and
social institutions on a world-wide basis, re
presentative groups within a framework of cul­
ture areas.

322. THE AMERICAN INDIAN.
(3-0) Cr. 3. Alt. W. Offered 1970.
Prerequisite: 218.
Origin and distribution of New World popula­
tions; 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 1969.
Prerequisite: 218.
Cultural backgrounds of contemporary groups
in Middle and South America; historic and pres­
cent 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 1970.
Prerequisite: 218.
Origin and distribution of native populations
in Middle and South America; survey of cultural
patterns of different ethnic groups; Aztec, Maya
and Inca civilizations; anthropological ap­
proaches to problems of aboriginal American
culture history; European contact and accul­
turation.
340. PRIMITIVE RELIGION.
   (3-0) Cr. 3. Alt. W. Offered 1971.
   Prerequisite: 218.
   The nature of magico-religious systems. Social integration of the supernatural. Nativistic cults and revivalism. Changes in aboriginal systems influenced by Western and Eastern religions.

400. LANGUAGE AND CULTURE.
   (3-0) Cr. 3. Alt. W. Offered 1970
   Prerequisite: 218.
   Language in culture. The 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.
   The prehistory and early history of North America as reconstructed from archaeological evidence; peopling of the New World; major cultural developments north of the Rio Grande.

421. KINSHIP AND THE FAMILY IN DIFFERENT CULTURES.
   (3-0) Cr. 3. S.
   Prerequisite: 218.
   Theories of kinship, marriage regulations, and divorce. Significance of kinship systems in organization of social life, cross-cultural approach to study of the family.

422. CULTURE AND PERSONALITY.
   (3-0) Cr. 3. W.
   Prerequisite: 218, Psych. 101.
   Relationship of cultural, social, and personality factors in human behavior. Analysis of generational transmission of culture.

423. THE ACQUISITION OF CULTURE.
   (3-0) Cr. 3. S.
   Prerequisite: 218, 422.
   Cross-cultural analysis of the ways by which the characteristic beliefs, values, attitudes and behaviors of a society are passed from one generation to the next.

424. ETHNOLOGY OF THE OLD WORLD.
   (3-0) Cr. 3. W.
   Prerequisite: 218.
   Analysis of selected old world cultures. Emphasis on Africa, Europe, Asia or Oceania.

425. INTERCULTURAL RELATIONS.
   (3-0) Cr. 3. F.
   Prerequisite: 218.

COURSES PRIMARILY FOR GRADUATE STUDENTS, major or minor, open to qualified undergraduates

Courses in Anthropology

529. ADVANCED ARCHAEOLOGICAL METHODS.
   Cr. 1 to 5. May be taken for 8 to 12 credits in summer field school.
   Prerequisite: 429 and consent of instructor.
   Archaeological field techniques and laboratory methods. Reconstruction of socio-cultural activities from archaeological evidence.

599. SPECIAL TOPICS.
   Cr. 1 to 5. F.W.S.
   Prerequisite: 15 credits in anthropology senior or graduate classification.
   A. General Anthropology
   B. North American Archaeology
   C. Kinship Studies
   D. American Indian
   E. Latin American Studies
   F. Culture and Personality.

COURSES FOR GRADUATE STUDENTS, major or minor

Courses in Anthropology

698. ADVANCED TOPICS IN ANTHROPOLOGY.
   (3-0) Cr. 3 each.
   A. General Anthropology
   B. Archaeology.

699. RESEARCH.
SOIL SCIENCE

For description of courses, see Agronomy.

SPAN

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; six for preparation and the field study, six for the report
and SPAN activity. Grades for the first six credits are determined by the group adviser; for
the final six credits the grades are determined jointly by the project counselor and the group
adviser. Classification may be in appropriate formal or "Special Topics" courses.

STATISTICS

Theodore A. Bancroft, Ph.D., Head of Department

Professors: C. Phillip Cox, M.A.; Herbert T. David, Ph.D.; Wayne A. Fuller, Ph.D.; David V.
George W. Snedecor, D.Sc. (Emeritus); B. V. Sukhatme, Ph.D.; Leroy Wolins, Ph.D.; George
Zyskind, Ph.D.

Associate Professors: Barry Arnold, Ph.D.; David F. Cox, Ph.D.; Donald K. Hotchkiss, Ph.D.;
David Jowett, Ph.D.; C. C. Mosler, B.S.; Edward Pollak, Ph.D.; Joseph Sedransk, Ph.D.; James
A. Walsh, Ph.D.; Richard D. Wafren, Ph.D.

Assistant Professors: Harold Baker, M.S.; Chien-pei Han, Ph.D.; Roy Hickman, Ph.D.; Paul
Hinz, Ph.D.; James L. Hutter, Ph.D.; Dean Isaacson, Ph.D.; Richard E. Lund, Ph.D.; Glen
Meeden, Ph.D.; Richard Mensing, Ph.D.; Shushikala Sukhatme, Ph.D.

Instructors: William J. Kennedy, Jr., M.S.; John C. W. Lin, M.S.; Abel G. Mexas, M.S.; Victor
Tang, M.A.; James Veale, M.S.; Milton Winger, 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.

The curriculum in sciences and humanities with a major in statistics is designed to pre­
pare 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 con­
ditions; 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: 201, 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 math­
ematics 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, non-specialized study which may be needed.

Students intending to do graduate work in statistics normally would take additional courses in mathematics.

Graduate Study

The department offers major work for the degrees Master of Science and Doctor of Philosophy 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 non-thesis basis. The non-thesis 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, 446, 447, 448, 481, 482, 499.

COURSES PRIMARILY FOR UNDERGRADUATE STUDENTS

201. PRINCIPLES OF STATISTICS.
(4-3) Cr. 5. F.W.S.
Prerequisite: 3 credits in mathematics.
Statistical concepts in modern society; frequency distributions; elements of statistical inference; contingency tables; introduction to regression, correlation; analysis of variance, single classification.
A: (2-3) Cr. 3. W.S. For students in agricultural and biological sciences. Prerequisite: 3 credits in mathematics. Emphasis on experimental problems from biological fields; elementary experimental design. B: (3-0) Cr. 3. F.S. For students in engineering. Prerequisite: Math. 110.
Emphasis on engineering applications. More emphasis on probability. Introduction to order statistics included.

327. ELEMENARY BUSINESS STATISTICS.
(2-3) Cr. 3. F.
Prerequisite: 201.
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.
(Math. 341, 342, 343) (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; non-parametric methods.

380. STATISTICAL APPLICATIONS OF DIGITAL COMPUTERS.
(Com.S. 380) (2-3) Cr. 3. F.W.S.
Prerequisite: 201, Com.S. 214 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.SSI. 402: W.S.SSII.
Prerequisite: 401: 201 or graduate classification, Math. 101; 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 cross classifications; introduction to multiple comparisons; factorials; individual degrees of freedom; multiple regression; covariance.

403. NONPARAMETRIC STATISTICAL METHODS.
(3-0) Cr. 3. Alt. F. Offered 1970.
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.S.SII. 
Prerequisite: 401. 
Methods of constructing and analyzing designs for survey investigations; simple random, stratified, multistage and multiphase sampling designs; questionnaire construction; methods of estimation; techniques of survey investigation.

431. ELEMENTARY STATISTICAL QUALITY CONTROL. (3-0) Cr. 3. S. 
Prerequisite: 201 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. The 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.

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; extension 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. Alt. F. Offered 1969. 
Prerequisite: 505. 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. SOCIOOMETRIC 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 inferences. Methods of sociological scaling, Index construction, and composite measures.

511, 512. DESIGN OF EXPERIMENTS. (3-0) Cr. 3 each. W.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, $2^m$ 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. W.S. 
Prerequisite: 521: 401, 448 or 541; 522: 521. Sedransk, B. V. Sukhatme. 
Comprehensive coverage 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: SAMPLING INSPECTION. (1.E. 531) (3-0) Cr. 3. F. 
Prerequisite: 343 or 448. Mensing. 
Control of quality of manufactured products. Attribute and variables inspection; single, double and sequential plans; sampling plans for continuous production. Cost functions and elementary decision functions.

532. INDUSTRIAL STATISTICS: DESIGN OF EXPERIMENTS. (1.E. 532) (3-0) Cr. 3. Alt. S. Offered 1971. 
Prerequisite: 402, 531. David. 

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.
(Eng 536, 537) (3-0) Cr. 3 each. F.W.
Prerequisite: 402, 448, Gen. 301; or Gen. 460.
Availibility or permission of instructor. Pollak.
Probability as applied to genetic systems, the
theory of inbreeding; estimation of genetic pa-
rameters and testing of genetic hypotheses;
models for quantitative inheritance; the parti-
tion of genotypic variance; covariances among
relatives with random mating and with selfing;
experimental designs for evaluating parameters;
phenotypic selection for quantitative traits.

538, ECONOMETRIC STATISTICS.
(Eng. 538) (3-0) Cr. 3. F.
Prerequisite: 448. Fuller.
Prerequisite and 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 replace-
melt, dynamic and recursive programming
methods of quantitative planning of economic
policies

539, OPERATIONS RESEARCH.
(Eng. 539) (3-0) Cr. 3. W.
Prerequisite: 343 or 448. Mensing.
Topics in game theory, programming, and the
theory of queues

540, OPERATIONS RESEARCH METHODS
AND ECONOMIC ANALYSIS.
(Eng. 540, I. E. 540) (3-0) Cr. 3. S.
Prerequisite: 446 or Math. 112, Econ. 537 or
Techniques of inventory control and manage-
ment; 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 replace-
melt, dynamic and recursive programming
methods of quantitative planning of economic
policies

541, 542, 543, THEORY OF PROBABILITY
AND STATISTICS.
(Math. 541, 542, 543) (3-0) Cr. 3 each. Yr.
Prerequisite: 541: Math. 414; 542: 541, Math.
415; 543: 542. Arnold, Meeden.
Development of distribution theory from the
theory of probability, common distribution func-
tions; derivation of sampling distributions with
particular attention to normal populations, es-
timation 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 1970.
Prerequisite: 539. David.
Admissibility and completeness, decision func-
tions; Bayes and minimax solutions; sequential
and nonsequential cases; utility and principles of
choice

545, STOCHASTIC PROCESSES.
(Math. 545) (3-0) Cr. 3. SSII.
Prerequisite: 541 or Math. 555. Arnold.
Stationary processes with emphasis on the time
domain; truncation and derived processes;
normal and Poisson processes, renewal theory;
Markov chains; harmonic analysis of processes

554, 555, PROBABILITY.
(Math. 554, 555) See Mathematics

580, STATISTICAL COMPUTATIONS ON
DIGITAL COMPUTERS I.
(Com.S. 580) (3-0) Cr. 3. W.
Prerequisite: 402, 448 or 542 or 548; Math.
404; Com.S. 214 or knowledge of Fortran.
Programming techniques and methods for so-
lution of problems in multiple linear regres-
sion, non-linear regression, analysis of variance

581, STATISTICAL COMPUTATIONS ON
DIGITAL COMPUTERS II.
(Com.S. 581) (3-0) Cr. 3. S.
Prerequisite: 580. Math. 414.
Topical in the use of digital computers for the-
etorical investigations in statistics evaluating
statistical distribution functions, Monte Carlo
techniques, programming symbolic operations

599, SPECIAL TOPICS.
Cr. arr.
A. Theory.
B. Methods.
C. Design of Experiments
D. Design of Surveys

COURSES FOR GRADUATE STUDENTS, major or minor

601, ADVANCED STATISTICAL METHODS.
(3-0) Cr. 3. F.
Prerequisite: 501: 448 or 543. C. P. Cox.
Prerequisite: 501. Principles of regression analysis; general ortho-
gonal polynomials; multivariate analysis in-
cluding Hotelling's $T^2$, the linear discriminant
function and the analysis of dispersion, regres-
sion non-linear in the parameters; seminars on
special topics

608, SEMINAR ON STATISTICAL METHODS.
Cr. arr.
Prerequisite: 501. 448 or 543

611, 612, ADVANCED DESIGN OF EXPERIMENTS.
(3-0) Cr. 3 each. Alt. W.S. Offered 1971.
Prerequisite: 512, 641. Kemphothe.
Randomization theory of designs, general theory
of factorial designs; fractional replication, theory of
quasifactorial and incomplete block designs,
analysis of groups of experiments, treatments
applied in sequence, designs for determining
optima

621, ADVANCED DESIGN OF SURVEYS.
(3-0) Cr. 3. Alt. W. Offered 1970.
Prerequisite: 522, 543. Sedransk, B. V. Suk-
hatme.
Advanced topics in sampling theory as used in
survey design, unequal probability-sampling with
and without replacement, unblased ratio and
regression type estimators, analytical treat-
ment of non-sampling errors

622, SEMINAR ON DESIGN OF SURVEYS.
Prerequisite: 621. Sedransk, B. V. Sukhatme.
Special topics of current interest in design of
surveys; review of recent literature

638, ADVANCED ECONOMETRIC
STATISTICS.
(Econ. 638) (3-0) Cr. 3. Alt. W. Offered 1970.
Prerequisite: 538. Fuller.
Simultaneous equation systems of economic rel-
ationships; Identification, methods of estima-
tion, and computational layout in distributed lag
models. Problems of specification, aggregation,
and prediction in econometric analysis

639, STOCHASTIC AND CONTINUOUS
PROGRAMMING.
(3-0) Cr. 3. Alt. F. Offered 1969.
Prerequisite: 539, 543. David.
Distributions of game values and program op-
tima. Generalized Chebycheff inequalities and
continuous programs.
Courses and Programs

641. GENERAL THEORY OF LINEAR HYPOTHESIS. (3-0) Cr. 3. F.
Prerequisite: 543, Math. 404. Zyskind.
Theory of least squares; theory of general linear hypothesis; analysis of multiple classification data; components of variance.

642. PROBABILITY AND DISTRIBUTION THEORY. (Math. 642) (3-0) Cr. 3. W.
Prerequisite: 643.
Probability measure and distribution functions; random variables; characteristic functions; asymptotic distributions.

643. THEORY OF ESTIMATION AND TESTING OF HYPOTHESIS. (3-0) Cr. 3. S.
Prerequisite: 543.
Neyman-Pearson theory of testing hypotheses; point and interval estimation; sufficient statistics; elements of decision theory.

644. SEQUENTIAL STATISTICAL DECISION THEORY. (3-0) Cr. 3. Alt. F. Offered 1970.
Prerequisite: 543, 544, one quarter of probability. David.
Several-source sequential analysis, optimal stop rules; Markovian sequential decision models.

646. TIME SERIES. (Econ. 646) (3-0) Cr. 3. Alt. S. Offered 1971.
Prerequisite: 448 or 543. Fuller.
Stochastic processes; covariance and spectral representations; moving average and auto-regressive schemes; Fourier and periodogram analyses; serial correlations; analysis of trend, seasonal variations and cyclical variations; method of variate differences.

647. MULTIVARIATE ANALYSIS. (3-0) Cr. 3. F.
Prerequisite: 543, Math. 404.
Multivariate normal distribution; Wishart distribution; Hotelling’s $T^2$, multivariate regression analysis; discriminant functions.

648. SEMINAR ON THE THEORY OF STATISTICS AND PROBABILITY. Cr. arr.
Prerequisite: 543.

649. RECENT DEVELOPMENTS IN STATISTICS AND PROBABILITY. (3-0) Cr. 3.
Prerequisite: 642, 643.
Material selected from an area of research such as sequential analysis, decision theory, non-parametric inference, stochastic processes.

680. SEMINAR ON STATISTICAL COMPUTATIONS. Cr. arr. F.
Prerequisite: 580 or 581, permission of instructor.
Computational aspects of the research topics of those individuals enrolled in the course. Algorithms for the solution of theoretical and applied problems in statistics.

699. RESEARCH. Cr. arr.

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. (Emeritus); Jane Saddler, M.S.; Geitel Winakor, Ph.D.

Associate Professors: Ruth E. Hall, Ph.D.; Agatha L. Huepenbecker, M.S.; Lucille Rea, M.S.


Instructors: Cornelia Buck, B.S.; Mary Burton, M.S.; Martha McKibben, M.S.; Arlene Stein, 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.
Two majors are offered: 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 major work for the degree Master of Science and minor work to students taking major work toward the degree Doctor of Philosophy, Master of Science or Master of Arts.

Prerequisite to major graduate work is the completion of courses in applied art, chemistry (including inorganic and organic), economics, physics, 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, 500.

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.

123. PATTERN MAKING AND CLOTHING CONSTRUCTION. (2-10) Cr. 5. F.W.S.
Prerequisite: Placement test-Z classification. Use of a commercial basic pattern; introduction to principles of flat pattern designing and pattern making; basic garment construction and construction for specific fabrics and designs.

125. PATTERN MAKING AND CLOTHING CONSTRUCTION. (2-7) Cr. 4. F.W.S.
Prerequisite: Placement test-X classification. For students who rank high on the placement test. 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 AND CLOTHING CONSTRUCTION. (2-4) Cr. 4. F.W.S.SSI.
Prerequisite: 123 or 125, credit or classification in 245. Draping with emphasis on designing, fitting and construction.

245. CLOTHING SELECTION. (2-3) Cr. 3. F.W.S.
Prerequisite: A.A. 103. Selection of appropriate and becoming clothing for individuals, with recognition of social, economic and design factors.

304. INTERMEDIATE TEXTILES. (3-0) Cr. 3. F.W.S.
Prerequisite: 104, Chem. 231 or equivalent. Application of basic principles of textiles in specific end uses; household textiles, clothing, non-woven textiles; textile testing; emphasis on serviceability, aesthetic, economic, and psychological aspects.

326. CHILDREN'S CLOTHING. (2-4) Cr. 3. F.W.S.
Prerequisite: 123 or 125. Selection of clothing as it relates to the growth and development of the child. Evaluation of ready-to-wear. Designing and construction of suitable clothing for children.

345. COSTUME DESIGN AND SELECTION. (2-4) Cr. 3. F.W.S.
Prerequisite: 245, A.A. 213 or 214. Creative problems based on source material commonly used in designing clothing.
474 Courses and Programs

365. TEXTILES AND CLOTHING MERCHANDISING.
(3-0) Cr. 3. W.
Prerequisite: I.Ad. 340 or Econ. 466.
Principles of merchandising as applied to clothing, accessories, and household textiles.

401. SENIOR STUDY TOUR.
Cr. R. F.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.
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.
Prerequisite: 104. Hist. 205, 206.
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.W.S.SSI.
Prerequisite: Hist. 205, 206.
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.

464. FAMILY CLOTHING CONSUMPTION.
(3-0) Cr. 3. F.W.S.SSI.
Prerequisite: 304, Econ. 242.
Current theories of clothing consumption, factors affecting family clothing expenditure; production and distribution of textile and clothing products for the consumer market.

465. INTRODUCTION TO SOCIOLOGICAL AND PSYCHOLOGICAL ASPECTS OF CLOTHING AND TEXTILES.
(3-0) Cr. 3. F.W.S.
Prerequisite: 104, 245, Psych. 101, Soc. 134.
Origins and functions of clothing and textiles for individuals and societies, primitive and modern.

490. SPECIAL PROBLEMS.
Cr. 1 to 4 per quarter. F.W.S.SSI.SSI.
Prerequisite: 10 credits in textiles and clothing. Permission from the department head and instructor.
A. Textiles.
B. Historic Textiles.
C. Clothing Construction.
D. Costume Design.
E. History of Costume.
F. Sociological and Psychological Aspects of Textiles and Clothing.
G. Economic Aspects of Clothing

COURSES PRIMARILY FOR GRADUATE STUDENTS, major or minor, open to qualified undergraduates

500. SHORT COURSE.
Cr. arr. SSI. SSIII.

501. INTERNATIONAL STUDY TOUR.
Cr. 1 to 8. SS.
Prerequisite: Junior, senior, or graduate classification. 414 or 454 or equivalent.
A short period of orientation (lectures, films, discussion, short field trips, and study) before travel to observe garments and textiles in mills, factories, homes, stores, laboratories, and museums. Country studied and visited will vary.

504. EXPERIMENTAL TEXTILES.
(2-4) Cr. 3. S.
Prerequisite: 404, senior or graduate classification.
Experience in planning, executing and reporting introductory studies in textile research; review of pertinent literature and testing of fabrics using equipment available.

523. EXPERIMENTAL CLOTHING CONSTRUCTION.
(2-4) Cr. 3. W.
Prerequisite: 225 or graduate standing. Saddler.
Experimental approach to the study of factors influencing sewing construction; evaluation of sewing techniques.

526. ADVANCED DRAINTING.
(2-4) Cr. 3. S.SS.
Prerequisite: 225, 345. Saddler.
Application of design and pattern making principles to various fabrics and styles.

528. THEORY OF PATTERN DRAFTING AND DESIGNING.
(3-6) Cr. 3.
Prerequisites: 225, senior or graduate classification.
Analytical study of commercial pattern characteristics. Drafting of personal basic pattern or "block" and application of drafting principles to a figure with fitting problems. Pattern designing on the drafter "block".

529. EXPERIMENTAL TAILORING.
(2-6) Cr. 4. W.
Prerequisite: 429 or equivalent. Senior or graduate classification.
Study of and experimentation in tailoring techniques as applied to various fabrics used in coats and suits.

544. ADVANCED COSTUME DESIGN.
(2-4) Cr. 3. W.
Prerequisite: 345.
Creative problems to meet individual needs, experience in designing for different ages and figures.

554. ADVANCED HISTORY OF COSTUME.
(2-0) Cr. 2-3. W.
Prerequisite: 454, senior or graduate classification.
Study of garments in the historic collection and their relationship to other sources of information; research techniques; individual study of selected periods.

565. THE SOCIOLOGICAL AND PSYCHOLOGICAL ASPECTS OF CLOTHING AND TEXTILES.
(3-0) Cr. 3. W.SS.
Prerequisite: 465. Warning, Hall.
Readings in and investigation of social and psychological aspects of clothing and textiles. Written and oral reports of research and renderings.
590. SPECIAL TOPICS.
F.W.S.SSI.
Prerequisite: Permission of the department head and professor or professors concerned.
A. Textiles. Hollen, Lewis, Saddler.
B. Historic Textiles. Huenkenbecker.
C. Clothing Construction.
D. Costume Design.
E. History of Costume. Winakor.
F. Socio-Psychological Aspects of Textiles and Clothing. Hall, Warning.

COURSES FOR GRADUATE STUDENTS, major or minor

610. SEMINAR.
Cr. arr. W. Winakor.

611. RESEARCH.
F.W.S.SSI.SSII.
Hall, Hollen, Warning, Winakor.

VETERINARY ANATOMY

Robert Getty, D.V.M., Ph.D., Head of Department

Professors: Neal R. Cholvin, D.V.M., Ph.D.; George C. Christensen, D.V.M., Ph.D.; Ralph L. Kitchell, D.V.M., Ph.D.
Instructors: Harpal S. Bal, B.V.Sc., M.S.; Daniel J. Hillmann, 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 major work for the degrees Master of Science and Doctor of Philosophy in microscopic and gross anatomy and minor work to students taking major work in other departments.

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 for graduate minor.

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 only: 401, 402, 403, 404.

COURSES PRIMARILY FOR UNDERGRADUATE STUDENTS

217. ANATOMY OF DOMESTIC ANIMALS.
(3-0) Cr. 3. F.
For second year students in agriculture, and other advanced students desiring fundamental knowledge of anatomy.

300. PROFESSIONAL ORIENTATION.
(1-0) Cr. R. F.
Prerequisite: First year classification in veterinary medicine.

301. MICROSCOPIC ANATOMY.
(2-8) Cr. 5. F.
Prerequisite: First year classification in veterinary medicine.
Cytology, basic tissues, and developmental anatomy.

302. MICROSCOPIC ANATOMY.
(3-6) Cr. 5. W.
Prerequisite: 301.
The body systems and organogenesis.
303. MICROSCOPIC ANATOMY.  
(1-10) Cr. 4. S.  
Prerequisite: 302.  
The body systems, endocrines, and fetal membranes.

311. GROSS ANATOMY.  
(0-14) Cr. 5. F.  
Prerequisite: First year classification in veterinary medicine.  
Systematic and topographic study and dissection of the dog.

312. GROSS ANATOMY.  
(0-15) Cr. 5. W.  
Prerequisite: 311.  
Systematic and topographic study and dissection of the horse, and comparative neurology.

313. GROSS ANATOMY.  
(0-13) Cr. 5. S.  
Prerequisite: 312.  
Systematic and topographic study and dissection of the ox, sheep, pig, chicken, and laboratory animals.

401. ADVANCED MICROSCOPIC ANATOMY.  
(2-8) Cr. 5. F.  
Prerequisite: One year of college biology.  
Cytology, basic tissues, and developmental anatomy.

402. ADVANCED MICROSCOPIC ANATOMY.  
(3-6) Cr. 5. W.  
Prerequisite: 401.  
The body systems and organogenesis.

403. ADVANCED MICROSCOPIC ANATOMY.  
(1-10) Cr. 4. S.  
Prerequisite: 402.  
The body systems, endocrines, and fetal membranes.

404. SYSTEMATIC ANATOMY.  
(1-6 or 12) Cr. 3 or 5 each time taken. SS.  
Prerequisite: One year of college biology, permission of Instructor.  
A. Ruminant Anatomy. Cr. 5.  
B. Non-ruminant Anatomy. Cr. 5.  
C. Anatomy for Biomedical Engineering. Cr. 3.  
D. Avian Anatomy. Cr. 3.

405. ADVANCED ANATOMY.  
(0-9) Cr. 3 to 5 each time taken. F.W.S.  
Prerequisite: 302, 312, permission of instructor.  
A. Regional systematic and topographic dissection of clinical, surgical and obstetrical areas as related to practice of veterinary medicine.  
B. Microscopic anatomy and its techniques as applied to organs and systems.

406. APPLIED ANATOMY.  
(2-3) Cr. 3. F.  
Prerequisite: Third year classification in veterinary medicine.  
Principal surgical, neurological, and obstetrical anatomical subject matter and its clinical application.

490H. SPECIAL PROBLEMS.  
Cr. 1 to 5 each time taken. Yr.  
Prerequisite: Permission of department head.

COURSES PRIMARILY FOR GRADUATE STUDENTS, major or minor, open to qualified undergraduates

510. ENDOCRINOLOGY.  
(V. Phys. 510) (4-3) Cr. 5. Alt. S. Offered 1971.  
Prerequisite: Permission of instructor. Getty, Haenly, Swenson.  
Embryology, structure and function of endocrine organs.

511. NEUROANATOMY.  
(V. Pth. 511) (2-0 or 2-6) Cr. 2 or 4. Alt. W. Offered 1970.  
Prerequisite: Permission of instructor. Getty, Kitchell, McKibben, Ramsey, Skold.  
Central and peripheral nervous system including the organs of special sense.

513. ANATOMY FOR BIOMEDICAL ENGINEERING.  
(3-3) Cr. 4. F.  
Prerequisite: Credit or classification in E.E. 301

Macroscopic and microscopic anatomy using the dog and subhuman primates. Designed primarily for students in biomedical engineering.

590. SPECIAL TOPICS.  
Cr. 2 to 5 each time elected.  
Prerequisite: 15 credits of acceptable graduate work, permission of instructor.  
A series of non-sequence 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

604. SEMINAR.  
Cr. 1. Yr. Getty.

690. RESEARCH.  
A. Gross Anatomy.  
B. Microscopic Anatomy.
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 shows 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 obstetrics dealing with interferences with parturition, diseases of the newborn, and interferences with normal reproduction commonly called "infertility."

A systematically organized course in radiology is presented, emphasizing the handling, taking, processing and interpretation of radiographs and the dangers of x-rays to man and animal when improperly used.

Graduate Study

The department offers major work leading to the degree Master of Science in the Veterinary Clinical Sciences. Both thesis and non-thesis options are available. Instruction is offered in veterinary medicine, surgery, radiology and the study of reproductive diseases. Minor work is available to students taking major work in other departments.

The laboratory facilities of the Veterinary Medical Research Institute are available to approved and qualified students.

Prerequisite to major graduate work is graduation from an approved college of veterinary medicine.

COURSES PRIMARILY FOR UNDERGRADUATE STUDENTS

391. DISTURBANCES OF REPRODUCTION. (4-0) Cr. 4. S. Prerequisite: First five quarters of veterinary curriculum. General principles of diseases causing disturbances in reproduction

394. GENERAL MEDICINE. (3-0) Cr. 3. S. Prerequisite: First five quarters of veterinary curriculum. General principles of diseases of large and small domestic animals

397. GENERAL SURGERY. (4-0) Cr. 4. 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 radiography and fluoroscopy with particular emphasis on protection from radiation and on interpretation of radiographs.
441. **SPECIAL SURGERY I.**  
\((2-0)\) Cr. 2. F.  
Prerequisite: First two years of veterinary curriculum.  
Surgical diseases of domestic animals

442. **SPECIAL SURGERY II.**  
\((5-0)\) Cr. 5. W.  
Prerequisite: 441.  
Surgical diseases of domestic animals

443. **SPECIAL SURGERY III.**  
\((2-0)\) Cr. 2. S.  
Prerequisite: 442.  
Surgical diseases of domestic animals

444. **CLINICAL MEDICINE I.**  
\((5-0)\) Cr. 5. F.  
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.**  
\((3-0)\) Cr. 3. S.  
Prerequisite: 445.  
Clinical diagnosis and treatment of diseases of domestic animals.

447. **SPECIAL TOPICS.**  
\((0-44)\) Cr. 6.  
Prerequisite: First three years of veterinary curriculum.

448, 449. **VETERINARY CLINICAL SCIENCES LABORATORY.**  
\((0-6)\) Cr. 2. F.W.S.  
Prerequisite: First two years of veterinary curriculum.

450. **SUMMER CLINICS.**  
\((0-44)\) Cr. 6. SSI.SSI.  
Prerequisite: First three years of veterinary curriculum.

451. **APPLIED VETERINARY SCIENCE.**  
\((0-39)\) Cr. 13. Yr.  
Prerequisite: Fourth year classification in veterinary medicine.

452. **RESEARCH.**

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**COURSE PRIMARILY FOR GRADUATE STUDENTS, major or minor, open to qualified undergraduates**

590. **SPECIAL TOPICS.**  
Cr. 1 to 5. F.W.S.  
Prerequisite: Permission of instructor

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**COURSES FOR GRADUATE STUDENTS, major or minor**

601. **SEMINAR.**  
Cr. 1. F.W.S.

640. **ADVANCED RADIOLOGY.**  
\((2-3 or 9)\) Cr. 3. F.W.S.  
Prerequisite: 440 or equivalent. Emmerson.  
Detailed principles of clinical radiology with particular reference to radiographic interpretation

644. **ADVANCED OBSTETRICS.**  
\((2-3 or 9)\) Cr. 3 or 5. Alt. W. Offered 1971.  
Prerequisite: 391, 447. Wagner.  
Diseases of reproductive organs of the male with special emphasis on diagnostic procedures

645. **ADVANCED OBSTETRICS.**  
\((2-3 or 9)\) Cr. 3 or 5. Alt. W. Offered 1970.  
Prerequisite: 391, 447. Wagner.  
Diseases of reproductive organs of the female with particular emphasis on recent advances in methods of diagnosis, treatment and control.

671. **ADVANCED GENERAL SURGERY.**  
\((2-3 or 9)\) Cr. 3 or 5. F.  
Prerequisite: 443. 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. W.  
Prerequisite: 443. 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 1970.  
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 1971.  
Prerequisite: 446 or equivalent. Wass, Buck.  
An advanced study of metabolic diseases.

678. **LABORATORY ANIMAL MEDICINE.**  
\((3-0)\) Cr. 3. Alt. SS. Offered 1971.  
Prerequisite: 446. Wass, Richter.  
Detailed principles of medicine and pathology of laboratory animals

690. **RESEARCH.**
VETERINARY MICROBIOLOGY AND PREVENTIVE MEDICINE
R. Allen Packer, D.V.M., Ph.D., Head of Department


Assistant Professors: Merwin L. Frey, D.V.M., Ph.D.; Patricia Gough, Ph.D.; Roger M. Hogle, D.V.M., M.S.

Instructors: Billy J. Edmundson, D.V.M.; JoAnn Heiner, B.S.; Loyd Jensen, D.V.M.

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 major work for the degree Master of Science in veterinary microbiology or veterinary preventive medicine, major work for the degree Doctor of Philosophy 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 curriculum substantially equivalent to that in veterinary medicine.

COURSES PRIMARILY FOR UNDERGRADUATE STUDENTS

381. GENERAL BACTERIOLOGY AND IMMUNOLOGY.
(3-9) Cr. 6-9.
Prerequisite: B & B, 304, 305 or equivalent. Morphology, classification, and physiological characteristics of pathogenic bacteria; principles of infection and immunity.

382. PATHOGENIC BACTERIOLOGY.
(4-6) Cr. 6-8.
Prerequisite: 381, V. Ph. 371. Detailed study of bacteria associated with animal diseases.

383. VIROLOGY AND PRINCIPLES OF EPIDEMIOLOGY.
(4-4) Cr. 5-9.
Prerequisite: 381, V. Ph. 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.
(3-0) Cr. 3 each. F.W.S.
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.
Prerequisite: Fourth year classification in veterinary curriculum. Principles of public health practice; epidemiology of food-borne illnesses and public health standards for the sanitary production of milk and milk products.

485. PUBLIC HEALTH II.
(3-0) Cr. 3.
Prerequisite: Fourth year classification in veterinary curriculum. Federal and state laws, regulations and procedures governing slaughter and or processing of meat food animals and food products of animal origin, methods of inspection and criteria for acceptability.

487. LIVESTOCK DISEASE PREVENTION.
(3-0) Cr. 3.
Prerequisite: Bact. 200 or 304. A survey of diseases of large domestic animals, including a discussion of the causes, transmission, disease processes and their control. Designed for students majoring in agricultural sciences.

488. POULTRY DISEASE PREVENTION.
(3-0) Cr. 3. Alt. S. Offered 1970.
Prerequisite: Bact. 200 or 304. A survey of diseases of poultry including a discussion of the causes, transmission, disease processes and their control. Designed for students majoring in poultry science.

490. SPECIAL PROBLEMS.
(1-5) Cr. arr.
Prerequisite: Permission of department head.
COURSES PRIMARILY FOR GRADUATE STUDENTS, major or minor, open to qualified undergraduates

509. GENERAL VIROLOGY.
(Bact. 509) See Bacteriology.

520. SEROLOGY.
(2-4) Cr. 4. F.
Prerequisite: 381 or Bact. 304. Kaeberle.
Principles of serology as applied to the diagnosis of infectious diseases and research in immunology.

522. PRINCIPLES OF EPIDEMIOLOGY.

COURSES FOR GRADUATE STUDENTS, major or minor

604. SEMINAR.
(1-0) Cr. 1. F.W.S. Packer.

625. PATHOGENIC BACTERIOLOGY.
(3-6) Cr. 5. S.S.
Prerequisite: 381, 382. Packer.
Advanced study of the pathogenic bacteria and technical procedures used in research.

626. ANIMAL VIROLOGY.
(3-4) Cr. 5. S.
Prerequisite: 509, permission of instructor. Mare.
Advanced study of animal virus-host-cell interactions and technical procedures utilized in animal virus research.

629. IMMUNOLOGY.
(3-6) Cr. 5. W.
Prerequisite: 520, 10 quarter credits in biochemistry, permission of instructor. Kaeberle.

690. RESEARCH.
Hofstad, Kaeberle, Manthei, Mare, Mott, Packer, Pier, Ross, Switzer, Wedman.

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 major work for the degrees Master of Science and Doctor of Philosophy in veterinary pathology and minor work to students taking major work in other departments.

It is possible to study for the degree Master of Science on a non-thesis 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>
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<th>Prerequisite</th>
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<tbody>
<tr>
<td>376, 377</td>
<td>VETERINARY PARASITOLOGY.</td>
<td>421: 371; 377: 421; 423: 376. Parasites and parasitic diseases of animals and the principles of their control.</td>
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### COURSES PRIMARILY FOR GRADUATE STUDENTS, major or minor, open to qualified undergraduates

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<tr>
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<tbody>
<tr>
<td>511</td>
<td>NEUROANATOMY.</td>
<td>V. An. 511 (2-4 or 6) Cr. 2 or 4. Alt. F. Offered 1970. Permission of Instructor.</td>
</tr>
<tr>
<td>551</td>
<td>GENERAL PATHOLOGY.</td>
<td>V. An. 303, 313, 315, 316. Ramsey, Duncan. Fundamentals of disease with emphasis on disease in animals.</td>
</tr>
<tr>
<td>554</td>
<td>VETERINARY TOXICOLOGY.</td>
<td>V. An. 304, 313, Ramsey. Pathogenesis of the major diseases affecting the animal body.</td>
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### COURSES FOR GRADUATE STUDENTS, major or minor

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<tr>
<td>604</td>
<td>SEMINAR.</td>
<td>Cr. 1. F.W.S.</td>
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<tr>
<td>654</td>
<td>VETERINARY NEUROPATHOLOGY.</td>
<td>V. An. 303, 313, Ramsey. Central and peripheral nervous systems including the organs of special sense.</td>
</tr>
<tr>
<td>655</td>
<td>PHYSIOPATHOLOGY OF THE SKELETAL SYSTEM.</td>
<td>V. An. 303, 313, Ramsey. Central and peripheral nervous systems including the organs of special sense.</td>
</tr>
<tr>
<td>656</td>
<td>ADVANCED VETERINARY PATHOLOGY.</td>
<td>V. An. 303, 313, Ramsey. Central and peripheral nervous systems including the organs of special sense.</td>
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### COURSES FOR GRADUATE STUDENTS, major or minor

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<td>657</td>
<td>ADVANCED VETERINARY TOXICOLOGY.</td>
<td>V. An. 303, 313, Ramsey. Advanced study of specific toxicants as related to animal diseases, public health hazards and the chronic effects of agricultural chemicals on animal tissues.</td>
</tr>
<tr>
<td>659</td>
<td>ADVANCED VETERINARY PARASITOLOGY.</td>
<td>V. An. 303, 313, Ramsey. Advanced study of specific toxicants as related to animal diseases, public health hazards and the chronic effects of agricultural chemicals on animal tissues.</td>
</tr>
<tr>
<td>660</td>
<td>PATHOLOGY OF PARASITIC DISEASES.</td>
<td>V. An. 303, 313, Ramsey. Advanced study of specific toxicants as related to animal diseases, public health hazards and the chronic effects of agricultural chemicals on animal tissues.</td>
</tr>
<tr>
<td>690</td>
<td>RESEARCH.</td>
<td>V. An. 303, 313, Ramsey. Advanced study of specific toxicants as related to animal diseases, public health hazards and the chronic effects of agricultural chemicals on animal tissues.</td>
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VETERINARY PHYSIOLOGY AND PHARMACOLOGY

Melvin J. Swenson, D.V.M., Ph.D., Head of Department


Instructors: William C. Edwards, D.V.M.; Rodney H. Ingraham, D.V.M.; Frederick N. Thompson, D.V.M.

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 in its broad sense is the science that investigates drugs, and for convenience of study often is subdivided into pharmacognosy, pharmacy, pharmacodynamics, and toxicology. Each of these 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 major work for the degrees Master of Science and Doctor of Philosophy in physiology and minor work to students taking major work 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 for graduate minor.

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: 314, 315, 316, 366, 367, 368, 490.

COURSES PRIMARILY FOR UNDERGRADUATE STUDENTS

264. 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. 304 and B. & B. 304 or V. An. 301 and 311. Physiology of body fluids, water, electrolytes, excretion, and respiration. Courses 314, 315, and 316 are designed for veterinary students and non DVM graduate 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. (6-4) Cr. 7. S.
Prerequisite: 315.
Physiology of the cardiovascular system, blood, skeletal muscle, energy, skin, endocrines, reproduction, and lactation.
366. AVIAN PHYSIOLOGY.  
(2-3) Cr. 3. Alt. W. Offered 1971.  
Prerequisite: 264 or equivalent.  
Basic physiological processes in poultry with emphasis on the chicken.

367. PHARMACOLOGY AND THERAPEUTIC PRINCIPLES.  
(4-3) Cr. 5. F.  
Prerequisite: 316.  
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. 6. W.  
Prerequisite: 367.  
Pharmacodynamics of drugs and their classes of importance in veterinary medicine.

490. SPECIAL PROBLEMS.  
Cr. 1 to 5 each time selected. Yr.  
Prerequisite: Permission of instructor.

COURSES PRIMARILY FOR GRADUATE STUDENTS, major or minor, open to qualified undergraduates

510. ENDOCRINOLOGY.  
(V.Am. 510) (4-3) Cr. 5. Alt. S. Offered 1971.  
Prerequisite: Permission of instructor. Engen, Getty, Swenson. Embryology, structure, and function of endocrine organs.

512. NEUROPHYSIOLOGY.  
(3-3) Cr. 4. W.  
Prerequisite: V. An. 511 or permission of instructor. Functions of the various brain areas, spinal cord, autonomic nervous system, and peripheral nerves, with emphasis on the brain. Laboratory exercises on stimulation and recording techniques, including electroencephalography.

514. PHYSIOLOGY FOR BIOMEDICAL ENGINEERING.  
(3-3 or 1-6) Cr. 4 or 1.  

515. PHYSIOLOGY FOR BIOMEDICAL ENGINEERING.  
(3-3 or 1-6) Cr. 4 or 1.  

518. DIGESTIVE PHYSIOLOGY.  
(3-3) Cr. 3. Alt. S. Offered 1970.  
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.

561. COMPARATIVE MAMMALIAN PHYSIOLOGY.  
(4-0 or 3) Cr. 4 or 5. W.  
Prerequisite: Credit or classification in V. An. 404 and B. & B. 304. Swenson. Designed for majors in physiology and for graduate students (with laboratory) minoring in physiology from animal, dairy, and poultry sciences; biological sciences, chemistry, home economics, and veterinary medicine. Same applies to 562 and 563. Physiology of body fluids, electrolytes, blood, excretion, and respiration.

562. COMPARATIVE MAMMALIAN PHYSIOLOGY.  
(4-0 or 3) Cr. 4 or 5. W.  
Prerequisite: 561. Crump. Physiology of the nervous system, digestion, absorption, and metabolism.

563. COMPARATIVE MAMMALIAN PHYSIOLOGY.  
(4-0 or 3) Cr. 4 or 5. S.  
Prerequisite: 562. Engen, Hembrough. Physiology of the cardiovascular system, skeletal muscle, energy, endocrines, reproduction, and lactation.

590. SPECIAL TOPICS.  
(1-5) Cr. 1 to 5.  
Prerequisite: Permission of instructor. Special work in instrumental methods, lactation, reproduction, psychotropic drugs, smooth muscle physiology, hematology, biochemistry of diseases, biomedical mathematics, or other subjects.

COURSES FOR GRADUATE STUDENTS, major or minor

604. 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.

660. DIGESTIVE PHYSIOLOGY.  
(3-3) Cr. 3. Alt. S. Offered 1970.  
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.  
(2-6) Cr. 4. S.  
Prerequisite: 563 or Zool. 553. Hembrough, Pearson. Study of basic physiology in animals with various fistulas, bypasses, and extirpations produced by surgical techniques.

690. 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.; Paul A. Hartman, Ph.D.; Keith M. Hussey, Ph.D.; Howard P. Johnson, Ph.D.; Mary S. Pickett, Ph.D.; John F. Timmons, Ph.D.

Major work in water resources is offered for the degrees Master of Science and Doctor of Philosophy under a cooperative arrangement with various departments including Agricultural Engineering, Agronomy, Bacteriology, Botany and Plant Pathology, Civil Engineering, Dairy and Food Industry, Earth Science, Economics, Family Environment, 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 development.

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 professor.

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 advisory committee. Introduction to water resources planning. Hydrology: 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 advisory committee. Water resources planning. The role of quality in water resources: physical, chemical, and biological aspects of water and waste water.

503. WATER RESOURCES III. (3-0) Cr. 3. S. Prerequisite: Permission of water resources advisory committee. Water resources planning. Legal, government, socio-economic, administrative, and planning aspects of water resources.

WILDLIFE BIOLOGY

For description of courses, see Zoology and Entomology.

ZOOLOGY AND ENTOMOLOGY

Oscar E. Tauber, Ph.D., Chairman of Department


Undergraduate Study

For undergraduate curriculum in sciences and humanities, major in zoology, see College of Sciences and Humanities, Curriculum. For undergraduate curricula in agriculture, majors in entomology or fisheries and wildlife biology, see College of Agriculture, Curricula.

Majors in the department find employment as teachers and research workers, wildlife and fishery biologists, entomologists, research aids, 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, parasitology, physiology, and in pre-professional programs in dentistry, marine zoology, medical technology, medicine, occupational therapy, pharmacology, and physical therapy.

Undergraduate majors in this department usually include the following basic courses in their programs: Biol. 101, 101A, 103; Zool. 106 (Biol. 106), 224, 227, 234, 274, 303, 307, 311, 355. As supporting work, undergraduate majors have found the following courses desirable: Gen. 301 or 400; Bot. 107 (Biol. 107); Chem. 101, 102, 103, 334, 335; Psych. 101; Soc. 134; Math. 101, 103, 110; Stat. 201; Geol. 100; Phys. 111, 112, 113; Bact. 300 (Biol. 300); 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. Those students interested should consult with, or write to, the department chairman.

Graduate Study

The department offers major work for the degrees Master of Science and Doctor of Philosophy in zoology, entomology, fisheries biology, and wildlife biology, and minor work in each of these fields. Specializations available include 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 upon previous training and experience in the major field of specialization.

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 water resources program; see Water Resources.

Zoology and Entomology is one of the cooperating departments in the biology program; see Biology.

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, 447, 448, 464, 465, 470.
Index to field of work is given by the second and third figures of course numbers:

- 00-09 General Zoology
- 10-19 Parasitology
- 20-29 Anatomy
- 30-39 Embryology
- 40-49 Wildlife Biology
- 50-59 Physiology
- 60-69 Fisheries Biology
- 70-79 Entomology
- 90-99 Problems and Research

**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 fisheries and wildlife biology.

†106. GENERAL ZOOLOGY.
(Biol. 106) (3-6) Cr. 5. F.W.S.SII.
Prerequisite: Biol. 101A.
Selected aspects of animal biology including classification, phylogeny, physiology, development and morphology. Emphasis on understanding the relationships between basic physiological functions and underlying organic forms.

156. ELEMENTARY HUMAN PHYSIOLOGY AND ANATOMY.
(3-4) Cr. 5. F.W.S.SII.
Prerequisite: High school chemistry credit or credit or classification in Chem. 101. Basic physiology and anatomy of human organ systems. Not accepted except by special permission for credit for students majoring in zoology.

224. COMPARATIVE ANATOMY.
(2-8) Cr. 4. F.W.S.
Prerequisite: 106.
Study of selected chordate types with emphasis on those not examined in general courses.

227. HISTOLOGY.
(2-6) Cr. 4. W.S.SII.
Prerequisite: 224.
Microanatomy of animals in relation to function.

234. VERTEBRATE EMBRYOLOGY.
(3-6) Cr. 5. F.W. S.
Prerequisite: 224 or V. An. 217. Introduction to principles and mechanisms of embryonic development of vertebrates.

*241. PRINCIPLES OF WILDLIFE CONSERVATION.*
(3-0) Cr. 3. W.
Prerequisite: Biol. 103.
History and biological basis of fish and wildlife conservation.

*274. GENERAL ENTOMOLOGY.*
(2-6) Cr. 4. F.W.S.SII.
Prerequisite: 106.
Structure, life history, habits and recognition of insects. Field trips.

301. ELEMENTS OF ANIMAL BIOLOGY.
(3-0) Cr. 3. F.
Prerequisite: Junior standing.
Topics in animal biology for the non-biology student. Not accepted for credit toward a major in zoology, or for students having had Biol. 101, Zool. 101, 102 or 106.

302. FIELD BIOLOGY.
(See list of courses offered at the Iowa Lakeside Laboratory).

*303. ANIMAL EVOLUTION.*
(3-0) Cr. 3. F.W.S.SII.
Prerequisite: 12 credits in biological sciences including Zool. 106; 224 recommended. Origin and evolution of animal life; sources and interpretation of evidence; principles as demonstrated in the animal kingdom.

*306. HERPETOLOGY.*
(2-3) Cr. 3. S.
Prerequisite: 106; 224 recommended. Biology, classification, and life histories of amphibians and reptiles. Field trips.

307. INVERTEBRATE ZOOLOGY.
(2-6) Cr. 4. S.SSI.
Prerequisite: 106; Biol. 103. Advanced study of invertebrates stressing classification, morphology, life history and evolutionary relationships. Field trips.

311. INTRODUCTION TO PARASITOLOGY.
(3-3) Cr. 4. F.W.
Prerequisite: 106; Biol. 103. Survey of major groups of animal parasites; biology and host-parasite relationships of parasitic protozoans, worms, acarines, crustaceans, insects, and vertebrates.

324. HISTOLOGICAL TECHNIQUES.
(1-9) Cr. 4. F.W.S.SII.
Prerequisite: 106; 227 recommended. Methods of fixing, sectioning, mounting and staining tissues for microscopic study.

325. MAMMALIAN ANATOMY.
(2-6) Cr. 4. S.
Prerequisite: 224.
Advanced study and dissection of cat, rabbit or other mammals. Designed for those preparing for study of medicine or related fields.

*340A. 340B. ORNITHOLOGY.*
340A: (2-3) Cr. 3. S.; 340B: (2-6) Cr. 4. S.
Prerequisite: 106; Biol. 103 recommended. Biology, classification, and identification of major groups of birds; laboratory and field work, including one-day trips to major bird habitats

355. PRINCIPLES OF PHYSIOLOGY.
(2-6) Cr. 4. F.W.S.SI.
Prerequisite: 106; Chem. 102; Chem. 334 recommended. Introduction to animal functions.

358. PRENATAL DEVELOPMENT.
(3-3) Cr. 4. F.W.S.
Prerequisite: Biol. 101A or Zool. 155. Physiological aspects of intra-uterine life; maternal-fetal relationships; reproductive hormones.

359. KINESIOLOGY.
(3-6) Cr. 5. F.W.S.SSI.
Prerequisite: 106 or 155. Analysis of human motion in terms of skeletal, articular and muscular systems. For physical education students. Not accepted for credit toward zoology major except by special permission.

†Zoology majors must have credit in Biol. 101 and 101A (or equivalents) before taking Zool. 106.
401. BIOLOGICAL ILLUSTRATION.
(See list of courses offered at the Iowa Lakeside Laboratory).

402. APPLIED ENTOMOLOGY.
(2-4) Cr. 4. F.
Prerequisite: Zool. 106 or Biol. 101A and 102B. Introduction to entomology and insect population management. Not open for credit to students having taken 274. Field trips.

403. BIOL. 274. APPLIED ENTOMOLOGY.
(2-4) Cr. 4. F.
Prerequisite: 15 credits in biological sciences. Description of life histories and populations of game birds and mammals; laboratory and field work, including extended trips.

405. SEMINAR.
(2-4) Cr. 2. W.
Prerequisite: 15 credits in biological sciences or major or minor in insectology. Open for credit to students having taken 274. Field trips.

*407. MAMMALOGY.
(0-4) Cr. 2. W.
Prerequisite: 15 credits in biological sciences. Techniques and principles of biological illustration with emphasis on illustrating for scientific publications.

*408. ANIMAL ECOLOGY.
(3-3) Cr. 4. F.
Prerequisite: 15 credits in biological sciences or major or minor in insectology. Ecosystem, community, population and habitat ecology of animals. Extended field trips.

*409. FUNDAMENTALS OF LIMNOLOGY.
(2-3) Cr. 3. S.
Prerequisite: 15 credits in biological sciences or major or minor in insectology. Physical and chemical features of inland waters and their biological communities. Techniques of limnological surveys. Field trips.

*410. ECONOMIC ENTOMOLOGY.
(2-4) Cr. 4. W.
Prerequisite: 274. Contemporary concepts of insect biology and insect population management.

411. PROTOZOOLOGY.
(2-6) Cr. 4. W.
Prerequisite: 307. Survey of the free-living and parasitic protozoans; evolution, identification, life cycles, and host-parasite relationships. See list of courses offered at the Iowa Lakeside Laboratory.

412. HELMINTHOLOGY.
(2-6) Cr. 4. F.
Prerequisite: 224, 307. Ulmer. 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. See list of courses offered at the Iowa Lakeside Laboratory.

413. ANIMAL CYTOLOGY.
(3-6) Cr. 5. F.
Prerequisite: 20 credits in biological sciences, including Zool. 335 and Gen. 301, permission of instructor; histological techniques recommended. The cell as a structural and functional unit. Role of nucleus and cytoplasm in cellular processes, development, and inheritance.

414. ETHOLOGY.
(3-3) Cr. 4. F.
Prerequisite: 15 credits in zoology; 303 recommended. Shaw. Comparative approach to study of animal behavior. Description, classification, analysis, and evolution of behavioral patterns of invertebrates and vertebrates. Special emphasis on orientation, communication, stereotyped behavior patterns, and underlying mechanisms.

415. PHYSIOLOGY OF REPRODUCTION.
(3-0) Cr. 3. W.S.
Prerequisite: 358, permission of instructor. Study and discussion of current research in human reproductive physiology.

*416. ICHTHYOLOGY.
(2-6) Cr. 4. S.
Prerequisite: 106; 224 recommended. Study and classification, and life histories of fishes. Field trips.

*417. FISHERIES MANAGEMENT.
(3-3) Cr. 4. F.
Prerequisite: 405, 464. Concepts and practices relating to maintenance and improvement of fishery resources and stream surveys for evaluations as fish habitat. Field trips.

418. ECONOMICS OF LIMNOLOGY.
(2-4) Cr. 4. W.
Prerequisite: 274. Contemporary concepts of insect biology and insect population management.

COURSES PRIMARILY FOR GRADUATE STUDENTS, major or minor, open to qualified undergraduates

500. SEMINAR.
Cr. 1. F.W.S.
Prerequisite: Permission of instructor. Tauber. Reports of research and current literature.

501. PRINCIPLES OF SYSTEMATIC ZOOLOGY.
(2-3) Cr. 3. Alt. W. Offered 1971.
Prerequisite: 15 credits in zoology. 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: 15 credits in zoology. Hicks. Relationships and developmental history of primates.

504. ARACHNOLOGY.
(2-6) Cr. 4. Alt. S. Offered 1971.
Prerequisite: 20 credits in biological sciences. Hicks. Biology, morphology, ecology, phylogenetic relationships, and economic importance of arachnids, especially mites, ticks and spiders.

507. ETHOLOGY.
(3-3) Cr. 4. F.
Prerequisite: 15 credits in zoology; 303 recommended. Shaw. Comparative approach to study of animal behavior. Description, classification, analysis, and evolution of behavioral patterns of invertebrates and vertebrates. Special emphasis on orientation, communication, stereotyped behavior patterns, and underlying mechanisms.

508. AQUATIC ECOLOGY.
(See list of courses offered at the Iowa Lakeside Laboratory).

511. PROTOZOOLOGY.
(2-6) Cr. 4. W.
Prerequisite: 15 credits in zoology; 307 or 311 recommended. Butter. Survey of the free-living and parasitic protozoans; evolution, identification, life cycles, and host-parasite relationships. See list of courses offered at the Iowa Lakeside Laboratory.

512. HELMINTHOLOGY.
(2-6) Cr. 4. F.
Prerequisite: 224, 307. Ulmer. 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. See list of courses offered at the Iowa Lakeside Laboratory.

528. ANIMAL CYTOLOGY.
(3-6) Cr. 5. F.
Prerequisite: 20 credits in biological sciences, including Zool. 355 and Gen. 301; permission of instructor; histological techniques recommended. The cell as a structural and functional unit. Role of nucleus and cytoplasm in cellular processes, development, and inheritance.
529. CYTOCHEMISTRY. 
(3-6) Cr. 5. S.
Prerequisite: 528 or Bot. 504; organic chemistry; permission of instructor; microtechnique recommended.
Theory and techniques for chemical analysis of individual cells. Interpretation of cell chemistry in relation to replication, differentiation and growth.

532. INVERTEBRATE DEVELOPMENTAL SYSTEMS. 
(3-0) Cr. 3. W.
Prerequisite: 234; 307 recommended. Brown.
Invertebrate embryonic development, asexual reproduction, and regeneration. Emphasis on principles of development.

538. EXPERIMENTAL EMBRYOLOGY. 
(3-6) Cr. 5. S.
Prerequisite: 234, organic chemistry; biochemistry and histological techniques recommended. Baker, Brown.
Physiology of germ cells; parthenogenesis; marking and grafting experiments on living embryos; tissue-culture techniques.

*540. WATERFOWL BIOLOGY AND CONSERVATION. 
(2-3) Cr. 3. Alt. W. Offered 1970.
Prerequisite: 224, 340. Weller.
Taxonomy, biology and conservation of waterfowl of the world. Extended field trips.

550. COMPARATIVE ANIMAL PHYSIOLOGY. 
(3-6) Cr. 5. S.
Prerequisite: 307 and 356; 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.SSI.
Prerequisite: 224 or V. An. 404 or equivalent; 356; 1 quarter organic chemistry; 1 quarter college physics. Griffith.
Primarily mammalian, systemic physiology with some cellular mechanisms. 551: Blood, nervous system, muscle 552: Circulation, respiration, digestion. 553: Metabolism, excretion, endocrinology.

555. GENERAL PHYSIOLOGY. 
(3-4) Cr. 5.
Prerequisite: Math. 110; courses in college physics, organic chemistry, and plant or animal physiology. Dunham.
Animal physiology from study of isolated cells and tissues.

*560. FISHERY ASPECTS OF WATER POLLUTION. 
(3-0) Cr. 3. Alt. W. Offered 1971.
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. W. Offered 1970.
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. Alt. W. Offered 1970.
Prerequisite: 274 or equivalent; Gen. 301. Peters.
Principles and mechanisms of insect control by host plant resistance.

*571. AQUATIC INSECTS. 
(2-6) Cr. 4. Alt. W. Offered 1971.
Prerequisite: 274, 405. Lewis.

*572. INSECT MORPHOLOGY. 
(2-6) Cr. 5. F.
Prerequisite: 15 credits in zoology, including 274. Lewis.
Intensive study of the external and internal anatomy and histology of insects.

*574. MEDICAL ENTOMOLOGY. 
(2-6) Cr. 4. S.
Prerequisite: 15 credits in zoology, including 274 or equivalent. Rowley.
Identification, life histories and control of insects and their relatives attacking man, particularly those forms which are disease vectors. Field trips.

*576. 577. SYSTEMATIC ENTOMOLOGY. 
(3-6) Cr. 5 each. W.S.
Prerequisite: 572. Laffoon.

590. SPECIAL TOPICS. 
Cr. 1 to 5 each time taken. F.W.S.SSI.SSI.
Prerequisite: 15 credits in zoology, permission of instructor.
A. Zoology. Baker, Brown, Buttrey, Dunham, Harding, Haupt, Hicks, Mutchmor, Redmond, Shaw, Tauber, Ulmer.
*C. Wildlife Biology. Haugen, Weller.
*D. Fisheries Biology. Bachmann, Carlander, Muncy.

*Courses administered by the College of Agriculture. All others administered by the College of Sciences and Humanities.

COURSES FOR GRADUATE STUDENTS, major or minor

601. ZOOLOGICAL LITERATURE. 
(3-0) Cr. 3. W.
Prerequisite: 15 credits in zoology. Knight.
Review of literature and classical authors of zoology and entomology; nomenclators; rules of zoological nomenclature.

*603. POPULATION DYNAMICS. 
(5-0) Cr. 5. Alt. W. Offered 1970.
Prerequisite: 402, Carlander, Pedigo.
Discussion of role of environmental and genetic variation in fluctuation of animal populations. 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.

*604. ZOOGEOGRAPHY. 
(3-0) Cr. 3. Alt. W. Offered 1970.
Prerequisite: 15 credits in zoology. Lewis.
Geographic distribution of animals.

*605. ADVANCED LIMNOLOGY. 
(3-6) Cr. 5. F.
Prerequisite: 405 or permission of instructor. Bachmann.

Environments and programs
612. ADVANCED PARASITOLOGY. (3-0) Cr. 3. S.
Prerequisite: 511, 512. Ulmer.
Special phases in host-parasite relationships of parasitic protozoans, worms and arthropods.

627. COMPARATIVE ADVANCED HISTOLOGY. (2-6) Cr. 4. W.SSI.
Prerequisite: 227, 234, 355.
Comparative study of normal tissues of invertebrates and vertebrates.

*645. WILDLIFE MANAGEMENT. (3-3) Cr. 4. Alt. W. Offered 1970.
Prerequisite: 227, 234, 355. Weller.
Theories and principles of wildlife conservation, management practices, and special topics.

654. COMPARATIVE ENDOCRINOLOGY. (3-0) Cr. 3. W.
Prerequisite: 551 or 552 or 553.
Structure and function of endocrine systems of invertebrate and vertebrate animals.

*655. INSECT PHYSIOLOGY. (3-0 or 6) Cr. 3 or 5. W.
Prerequisite: 355 or 555; equivalent of 572 or permission of instructor. Mutchmor.
Life processes, organ functions of insects.

*662. TECHNIQUES OF FISHERIES. (3-3) Cr. 4. Alt. S. Offered 1970.
Prerequisite: 465; Stat. 402. Muncy.
Critical analysis of methods for studying fish growth, food habits, population estimation and mortality rates.

*663. FISHERIES RESOURCES. (3-0) Cr. 3. Alt. W. Offered 1971.
Prerequisite: 465. Muncy.
Survey of fishery resources; analysis of problems concerned with commercial and sport fisheries and their management.

*675. INSECT TOXICOLOGY. (3-0) Cr. 3. Alt. S. Offered 1970.
Prerequisite: 555 or 655, 572. Dahm.
Chemistry and mode of action of modern insecticides.

690. THESIS RESEARCH.
A. Zoology. Brown, Buttrey, Griffith, Hicks, Mutchmor, Redmond, Shaw, Ulmer.
D. Fisheries Biology. Bachmann, Carlander, Munch.

698. SEMINAR IN CELL BIOLOGY. (B. & B. 698, Bot. 698E, Gen. 698) (1-0) Cr. 1. S.
Prerequisite: Permission of instructor. Bowen.
Discussions of concepts and research in cell biology.

**COURSES OFFERED AT THE IOWA LAKESIDE LABORATORY

302. FIELD BIOLOGY. (4-12) Cr. 4. SSI.
Must be taken concurrently with Bot. 301. Animals in the field, with emphasis on collection, identification, preservation, and laboratory culturing methods. May not be used as a substitute prerequisite for advanced courses listing 106 as a prerequisite. Field trips.

*371. FIELD ENTOMOLOGY. (8-24) Cr. 8. SSI.

490. SPECIAL PROBLEMS IN ZOOLOGY.
(See preceding section).

508, 509. AQUATIC ECOLOGY. (8-24) Cr. 8 each. SSI. SSI.
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.

511. PROTOZOOLOGY. (8-24) Cr. 8. SSI.
Prerequisite: 15 credits in zoology, 307 or 311 recommended. Survey of the free-living and parasitic protozoans; evolution, identification, life cycles, and host-parasite relationships.

512. HELMINTHOLOGY. (8-24) Cr. 8. SSI.
Prerequisite: 224, 307. 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).

690. THESIS RESEARCH.
(See preceding section).

**Permission of the instructor is a prerequisite for all courses offered at the Iowa Lakeside Laboratory.

*Courses administered by the College of Agriculture. All others administered by the College of Sciences and Humanities.
Technical Institutes

Agriculture

Engineering Technology

Food Service Management


Associate Professors: Carl Arnbal, M.S.; Edgar V. Collins, M.S.; Joe V. Crawford, M.S.; Pilar Garcia, Ph.D.; Rudolph J. Lubsen, M.S.; Robert M. Nady, M.S.; Aldor C. Peterson, M.S.; John B. Sheeler, Ph.D.


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 technical agriculture, engineering technology and food service management. Each is administered by the appropriate college of the University, and graduates receive the diploma as an associate.

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.

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.
The Technical Agriculture Program

Harold R. Crawford, M.S., Assistant Professor in Charge

The purpose of the program in technical agriculture is to provide two years of technical education for the person who wishes to become a farm operator or who wishes to seek employment in a business or industry closely related to agriculture. Emphasis is placed on the skills and technical knowledge of agricultural production and the marketing of products produced by the farmer or used on the farm.

To qualify for admission, a student must be a high school graduate and have credit for at least one year of algebra.

All students admitted to the technical agriculture program must take special aptitude tests administered at Iowa State University and be interviewed by and accepted by the Assistant Professor in Charge of the Technical Agricultural Program. Only a limited number of students can be accommodated each year. Therefore, it is necessary to select very carefully those students whose abilities, interests and aspirations conform closely to the objectives of a two-year technical educational program.

Technical Agriculture

Leading to the diploma Associate in Agriculture. Total credits required, 98.

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<th>FALL QUARTER</th>
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<td>English Composition II Engl. 21</td>
<td>Public Speaking Sp. 30</td>
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<td>Fundamentals of General Chemistry Chem. 30</td>
<td>Animal Production An. S. 14</td>
<td>Economics of Business Econ. 31</td>
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<td>Crop Production Agron. 14</td>
<td>Fundamentals of General Chemistry Chem. 31</td>
<td>Soils Agron. 24</td>
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<td>Construction and Maintenance of Agricultural Structures and Equipment A.E. 54</td>
<td>Basic Mathematics Math. 40</td>
<td>Power Sources for Agricultural Industries</td>
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<td>Agricultural Policy Econ. 51</td>
<td>Farm Accounts and Business Analysis Econ. 61 (4 cr.)</td>
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<td>Agricultural Machinery A.E. 34</td>
<td>Human Relations Soc. 35</td>
<td>or Accounting in Business I. Ad. 50 (5 cr.)</td>
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<td>Psychology of Interpersonal Relationships Psych. 50</td>
<td>Soil Fertility Agron. 34</td>
<td>Soil and Crop Management Agron. 44</td>
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¹Adapted Sports  
²Optional
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 young men 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 men, 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.

**Continuing Education - Bachelor of Science Preparation**

The student who graduates from engineering technology in the upper half of his class is qualified to enter an especially prepared program leading to the degree Bachelor of Science in engineering operations. This program normally will require completion of an additional 145 quarter credits as approved by his adviser and department head.

Completion will advance his knowledge of the fundamentals of management, engineering, physical sciences, and/or human behavior. Graduates will find opportunities in fields of advanced engineering technology, sales, management or production depending on their own specific interests.

See College of Engineering, Curriculum in Engineering Operations.

**Chemical Industries Technology**

Leading to the diploma Associate in Applied Science. Total credits required, 100.

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**First Year**

- **Technical Orientation**
  - G. Tch 10
- **Applied Mathematics**
  - Math 50
- **English Composition I**
  - Engl 20
- **Fundamentals of General Chemistry I**
  - Chem 30
- **Technical Drawing**
  - A. Gr. 40
- **Technical Problems I**
  - G. Tch 14
- **Technical Orientation**
  - G. Tch 11
- **Applied Mathematics**
  - Math 51
- **Applied Physics I**
  - Phys 71
- **Fundamentals of General Chemistry II**
  - Chem 31
- **Industrial Stoichiometry I**
  - C.I. Tch. 10
- **Library Instruction**
  - Lib 102
- **Technical Orientation**
  - G. Tch 12
- **Applied Mathematics**
  - Math 52
- **Applied Physics II**
  - Phys 72
- **Fundamentals of Organic Chemistry**
  - Chem. 32
- **Industrial Stoichiometry II**
  - C.I. Tch. 11
- **Technical Problems III**
  - G. Tch 16

**Second Year**

- **Basic Chemical Industries**
  - C.I. Tch. 51
- **DC and AC Machines**
  - E. Tch. 71
- **Graphical Mathematics**
  - A. Gr. 47
- **Quantitative Chemical Analysis**
  - Chem. 60
- **Unit Operations I**
  - C.I. Tch. 61
- **English Composition II**
  - Engl 21
- **Measurements and Instrumentation**
  - E. Tch. 72
- **Survey of Accounting**
  - I. Ad. 75
- **Instrumental Quantitative Analysis**
  - Chem 61
- **Unit Operations II**
  - C.I. Tch. 62
- **Letter and Report Writing**
  - Engl 40
- **Process Control**
  - C.I. Tch. 72
- **Public Speaking**
  - Sp. 30
- **Process Layout**
  - C.I. Tch. 80
- **Unit Operations III**
  - C.I. Tch. 63
## Construction Technology

Leading to the diploma Associate in Applied Science. Total credits required, 105.

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<td>Structural and Building Drawing</td>
<td>Elementary Surveying</td>
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<td>Soils Technology I</td>
<td>Letter and Report Writing</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.

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### Courses and Programs

**Construction Technology**

Leading to the diploma Associate in Applied Science. Total credits required, 105.

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**Second Year**

| **Route and Construction Surveying**<br>C. Tch 81 | | **Soils Technology I**<br>C. Tch 90 | 3 | **Letter and Report Writing**<br>Engl 40 | 3 |
| **Land Surveying I**<br>C. Tch 87 | 5 | **Structural Design I**<br>C. Tch. 92 | 5 | **Survey of Accounting**<br>I. Ad 75 | 3 |
| **Highway and Municipal Drawing**<br>C. Tch 83 | 4 | **Properties of Materials**<br>A. M. 31 | 3 | **Hydraulics**<br>A. M. 33 | 4 |
| **Strength of Materials**<br>A. M. 32 | 4 | **Concrete**<br>A. M. 34 | 4 | **Electives**¹ | 6 |
| **Public Speaking**<br>Sp 30 | | | | | |
| **18** | **18** | **3** | **16** | | |

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.

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| **Second Year**        |                        |                        |
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| and Circuits           | 1  E Tch 64            | and Circuits           | 1  E Tch 65            |
| Electronics Laboratory | 4  E Tch 97            | Technical Design       | 4  E Tch 84            |
| E Tch 96               |                        | Special Topics         | 4  E Tch 99            |
| Systems Analysis       | 4  E Tch 92            | Public Speaking        | 2  Sp 30               |
| E Tch 96               |                        | Introduction to Business and Industrial Organization | 3  I Ad 99 |
| Microwave Fundamentals |                        | Library Instruction    | 3  Lib 102             |
| E Tch 83               |                        | **Total Credits:** 17  |                        |
| Letter and Report Writing | Engl 40                | **Total Credits:** 18  |                        |
| Electronics Shop       | 3  A Gr 44             |                        |                        |
| E Tch 83               | 3  Survey of Accounting|                        |                        |
| **Total Credits:** 18  | 3  I Ad 75             |                        |                        |
|                        | 3  Library Instruction |                        |                        |
|                        | 1  Lib 102             |                        |                        |
Mechanical Technology

Leading to the diploma Associate in Applied Science. Total credits required, 106.

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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 his or her 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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| **Second Year** | | |
| Introduction to Quantity Food Production | Quantity Food Production Procedures | Management Aspects of Quantity Food Production |
| I. M. 61 | I. M. 62 | I. M. 63 | 4 |
| Purchasing Food Products | Financial Control | Sales Promotion and Public Relations |
| I. M. 84 | I. M. 87 | I. M. 83 | 4 |
| Food Service Facilities Planning and Equipment | Building Maintenance Management | Personnel Procedures |
| I. M. 85 | I. M. 89 | I. M. 88 | 4 |
| Psychology of Interpersonal Relationships | Human Relations | Letter and Report Writing |
| Psych. 50 | Soc 35 | Engl 40 | 3 |
| Seminar | Seminar | 1 |
| I. M. 91 | I. M. 92 | I. M. 93 | 1 |
| | | | 16 |
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. indicating which of the four quarters—fall, winter, spring, summer session—of the academic year the course is offered.

Agriculture

10. 11. 12. TECHNICAL AGRICULTURE ORIENTATION.
(1-0) 10: Cr. R. F.; 11: Cr. 1. W.; 12: Cr. 1. S.
10: Lectures and discussion to aid the first year technical agriculture student in adjusting himself to his studies and Iowa State University.
11: Lectures and discussion on new developments and practices in agriculture technology.
12: Basic considerations in career planning and job opportunities.

21. 22. 23. AGRICULTURAL OCCUPATION EXPERIENCE.
(0-6) Cr. 2 each: 21; S; 22; F; 23: W.
Prerequisite: Permission of department head.
Offered on pass-fail basis only.
21: First work period in an approved training center for agricultural occupations.
22: Second work period.
23: Third work period. Students must register for these courses prior to commencing each work period.

Agricultural Engineering

34. AGRICULTURAL MACHINERY.
(3-3) Cr. 4. F.
Principles of operation of tillage, planting and harvesting machines. Operating adjustments, calibration, performance evaluation, and service of agricultural machinery.

36. POWER SOURCES FOR AGRICULTURAL INDUSTRIES.
(2-6) Cr. 4. S.
Principles of operation of the internal combustion engine and the electric motor. Horsepower conversion, cost of operation, and efficiency of types of power as related to equipment in the agricultural industry.

54. CONSTRUCTION AND MAINTENANCE OF AGRICULTURAL STRUCTURES AND EQUIPMENT.
(2-6) Cr. 4. F.
Selection and application of metals, concrete and wood materials; includes welding, metal work, casting concrete, and wooden construction.

64. FARM ELECTRICAL EQUIPMENT.
(2-6) Cr. 4. S.
Prerequisite: Enrollment in two-year program in agriculture.
Application of electrically operated equipment to agricultural production. Electrical safety.

Agronomy

14. CROP PRODUCTION.
(3-3) Cr. 4. F.
Introduction to plant-soil-climate relationships in crop production.

24. SOILS.
(3-3) Cr. 4. S.
Prerequisites: Chem. 30, 31; Agron. 14.
Formation, classification, productivity and conservation of soils.

34. SOIL FERTILITY.
(3-3) Cr. 4. W.
Prerequisite: Agron. 24.
Characteristics and behavior of the essential plant nutrients in soil. Fertility programs.

44. SOIL AND CROP MANAGEMENT.
(4-0) Cr. 4. S.
Prerequisite: Agron. 34.
Integrating the principles of the soil, crop and climatological sciences into practical land use systems that maximize profits. Characteristics and use of fertilizers and agri-chemicals used in crop production.

Animal Science

14. BASIC CONCEPTS OF ANIMAL SCIENCE.
(3-2) Cr. 4. W.
Distribution and adaptability of livestock. The anatomy and physiology of farm animals as related to production. Wholesale and retail cuts of carcasses. Breeding, feeding and reproduction.

18. ANIMAL NUTRITION AND FEEDING PRACTICES.
(3-3) Cr. 4. F.
Feeding and management of hogs, sheep, beef and dairy cattle and horses. Ration formulation and feeding methods.

50. PERFORMANCE TESTING AND EVALUATION OF BREEDING STOCK.
(2-4) Cr. 4. W.

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 pro-
jection and pictorial drawing. Geometry of bear-
ing, slope, true length and true size. Standards
for sections, symbols and basic size specifications
for sections, symbols and basic size specifications.

41. ELECTRONICS DRAWING I. (0-0) Cr. 2. W.S.
Lettering, freehand sketching, theory of ortho-

graphic projection of points, lines, planes and
solids. Standards for sections, dimensioning, ba-
sic fasteners and reproduction of drawings.

42. ELECTRONICS DRAWING II. (0-0) Cr. 2. W.S.
Prerequisite: 41. Credit or classification in E.Tech.
89.
Applications of the principles of technical draw-
ing and development of skills in producing draw-
ings of electronic circuits and equipment. Dis-
cussion of standard symbols and nomenclature,
and short cuts in describing complex wiring
layouts. Empirical equations derived from plots
constructed from test data. Alignment charts.
Practice in producing circuit diagrams for formal
presentation.

45. TECHNICAL GEOMETRY. (1-6) Cr. 3. W.S.S.
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 sup-
pied to the shop or to be used wherever a
product is manufactured, fabricated or erected.
Specifications of size, shape, material and manu-
facture. Standard fastener specifications, includ-
ing threads, welds, rivets, keys, splines and
springs. Allowance specifications for mating parts
and standards of surface quality. Graphic illus-
tration for interpretation and presentation.

47. GRAPHICAL MATHEMATICS. (0-6) Cr. 2. F.S.S.S.
Prerequisite: 40, credit or classification in Math.
52.
Graphical representation of technical data.
Standards of curve plotting. Empirical equations
derived from plots constructed from test data.
Alignment charts. Graphical calculus.

Applied Mechanics

30. INTRODUCTORY MECHANICS. (4-4) Cr. 4. F.S.
Prerequisite: Phys. 72. 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 pro-
ties, 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, ulti-
mate strength and endurance limit. Specific phys-
ical properties of the ferrous metals, aluminum
alloys, other metals, wood, and clay products.

32. STRENGTH OF MATERIALS. (4-0) Cr. 4. F.W.S.S.
Prerequisite: 30.
Elements of stress analysis as applied to axially
loaded members, riveted and welded joints,
beams, circular shafts, helical springs and col-
umns when subjected to static, repeated or
impact loading.

33. HYDRAULICS. (3-3) Cr. 4. S.S.S.
Prerequisite: 30.
Study of hydrostatic pressure, flow of water in
a pressure conduit system, open channel flow,
weirs, venturi meters and a brief study of hy-
drology.

34. CONCRETE. (2-6) Cr. 4. W.S.
Prerequisite: Credit or classification in 31.
Study of the types of cement, concrete aggre-
gates, 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 non-metallic ele-
ments.

32. FUNDAMENTALS OF ORGANIC CHEMISTRY.
(2-6) Cr. 4. S.
Prerequisite: 31.
Principles of organic chemistry, aliphatic, and
olefin compounds, functional groups, polymers
and short cuts in describing complex wiring
layouts. Empirical equations derived from plots
constructed from test data. Alignment charts.
Practice in producing circuit diagrams for formal
presentation.

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 ap-
pied to manufacturing and engineering uses.

Chemical Industries Technology

10. INDUSTRIAL STOICHIOMETRY I. (0-0) Cr. 3. W.
Prerequisite: Credit or classification in Chem.
30, Math. 50, Phys. 71.
Engineering units, systems of measurement, in
duction 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 prob-
lems.
51. BASIC CHEMICAL INDUSTRIES.
(3-0) Cr. 3. F.W.
Prerequisite: Chem. 32.
History, economics, raw materials, manufacturing processes and products of selected chemical industries. Emphasis on the petro chemical, fertilizer, gypsum, pharmaceutical, plastics, rubber, corn milling and oil seed extraction industries of Iowa.

52. 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.

53. UNIT OPERATIONS OF THE CHEMICAL INDUSTRIES II.
(2-6) Cr. 4. W.
Prerequisite: 61.
Applications of filters, centrifugal, flotation and cyclones. Principles of heat transfer applied to heat exchangers, evaporators and dryers.

54. UNIT OPERATIONS OF THE CHEMICAL INDUSTRIES III.
(2-6) Cr. 4. S.
Prerequisite: 62.
Physical chemical separation operations including absorption, distillation, extraction and crystallization.

55. PROCESS CONTROL IN THE CHEMICAL INDUSTRIES I.
(2-6) Cr. 4. S.
Prerequisite: 62, credit or classification in E. Tech. 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.

56. PROCESS LAYOUT IN THE CHEMICAL INDUSTRIES.
(0-9) 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.
(0-9) 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. Chainage, differential and profile leveling, traversing, errors of closure, computation of areas, stadia and its application to topographic mapping.

81. ROUTE AND CONSTRUCTION SURVEYING.
(2-9) Cr. 5. F.S.S.
Prerequisite: 80, Math. 51.
Theory and field practice in circular, spiral, and vertical curves. Field and office work involved 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, columns, retaining walls and footings.

83. HIGHWAY AND MUNICIPAL DRAWING.
(2-6) Cr. 4. F.S.S.
Prerequisite: Credit or classification in 81 and 87.
Preparation of plan and profile drawings for highways, municipal street improvements, drainage ditches, transmission lines and various types of pipe lines. Drafting work connected with topographic maps, culverts, drainage systems and other structural drawings related to highway and road construction work.

85. CONSTRUCTION METHODS (STRUCTURES).
(2-3) Cr. 3. S.
Prerequisite: 82.

86. CONSTRUCTION METHODS (HIGHWAYS).
(2-3) Cr. 3. S.SS.
Prerequisite: 83.
Study of various types of equipment used in earth moving. Methods of excavation, compaction of fills, clearing and other operations related 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 organization and operation of construction companies and consulting engineers.

87. LAND SURVEYING I.
(2-9) Cr. 5. F.S.S.
Prerequisite: 60, Math. 51.
Study of the general instructions for the subdivision of public land in the United States. Surveys 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. Determination of meridian by astronomical observations.

88. LAND SURVEYING II.
(3-0) Cr. 3. S.SS.
Prerequisite: 87.

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 stabilization, soil construction control and inspection.

91. SOILS TECHNOLOGY II.
(2-3) Cr. 3. S.SS.
Prerequisite: 90, 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.
Prerequisite: 82, A.M. 32, credit or classification in A.M. 31.
Theory and design of steel and timber structures 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 structures, including beam and column design.

94. PHOTOGRAMMETRY.  
(1-6) Cr. 3. S. SS.  
Prerequisite: 83, Math. 52.  
Mapping by use of aerial photographs. Interpretation 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 mixtures; 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, diminishing returns, substitution, opportunity costs and monetary costs and returns.

41. AGRICULTURAL BUSINESS ANALYSIS.  
(2-4) Cr. 4. F.  
The marketing system for farm products and production inputs. The sources and uses of marketing information. Analysis of capital structure, budgeting, and long-run planning of agricultural marketing firms including cooperatives. Inventory, hedging, pricing, and personnel policies. Field trips to marketing and processing firms.

51. AGRICULTURAL POLICY.  
(4-0) Cr. 4. S.  
Patterns of land tenure. The role of the USDA in economic development. The Land Grant system of education, research, and Extension. Basic causes and possible remedies for economic problems in agriculture and other sectors. Agriculture's role in a strong democracy. Regulatory functions and agencies of federal, state and local governments. Taxation policies of federal, state and local governments.

61. FARM ACCOUNTS AND BUSINESS ANALYSIS.  
(4-0) Cr. 4. S.  
The application of economic principles to the organization and management of a farm. The purposes and methods of keeping farm records and accounts. Farm planning and enterprise analysis. Ownership and leasing arrangements. Sources and uses of agricultural credit.

Electronics Technology

56, 57. ELECTRIC CIRCUITS LABORATORY.  
(0-2) Cr. 1 each. 56: W. S.; 57: S. 88.  
Prerequisite: 56: Credit or classification in 86; 57: 56, credit or classification in 87.  
Laboratory investigation of DC and AC circuit principles. Report writing.

59, 63, 64, 65. ELECTRONICS LABORATORY.  
(0-2) Cr. 1 each. 59: S. 88.; 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 machines.

72. MEASUREMENTS AND INSTRUMENTATION.  
(1-2) Cr. 2. W. S.  
Prerequisite: 87 or Phys. 72. Measurement of physical characteristics. Transducers, indicators, recorders, controllers, actuators and industrial electronics.

80, 83. ELECTRONICS SHOP.  
80: (1-3) Cr. 2. W. S.; 83: (1-6) Cr. 3. F.  
Prerequisite: 80: Phys. 72 or credit or classification in 86; 83: 87; 89, 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 designing and constructing an item of electronic equipment. A written technical report and periodic 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: 85: Credit or classification in Math. 50 and G. Tech. 14; 86: 85, 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.  
(3-0) 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.  
(3-3) Cr. 4. W. S.  
Prerequisite: 57, 59, 87, 89.  

92. MICROWAVE FUNDAMENTALS.  
(3-3) Cr. 4. F. S.  
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 63; 95: 57, 59, 87, 89, credit or classification in 63.  
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.
Courses and Programs

502  Courses and Programs

97.  ELECTRONIC SYSTEMS.
     (4-3) Cr. 5. W.
     Prerequisite: 96.
     Performance and function of electronic circuits in operational electronic systems.

99.  SPECIAL TOPICS.
     (3-2) Cr. 4 each time elected.
     Prerequisite: Permission of instructor.

English

20.  21.  ENGLISH COMPOSITION.
     (3-0) Cr. 3 each 20: F.W.; 21: W.S.
     Prerequisite: 21: 20 or equivalent.
     Principles of written composition, including grammar, mechanics, punctuation, vocabulary and sentence structure. Practice in expository writing.

40.  LETTER AND REPORT WRITING.
     (3-0) Cr. 3. F.W.S.SS.
     Prerequisite: 21 or equivalent.
     Discussion of form and layout of formal pieces of writing. Practice in formal presentation of material from technical projects.

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.
     (0-6) Cr. 2. F. W.
     Prerequisite: Credit or classification in Math. 50.

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.
     Cr. 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 elected.
     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.
     (3-0) Cr. 3. F.W.S.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.S.
     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 and I. Ad. 50.
Budgeting, interpretation of financial statements, internal control of various costs for food service institutions.

88. PERSONNEL PROCEDURES.
(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: 85, T. & C. 40.
Considerations in selection of building materials and furnishings. Building maintenance procedures and equipment. Field trips required.

90. SPECIAL PROBLEMS.
Cr. Arr. F.W.S.S.S.I.
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. W.
Use of libraries and books.

Mathematics
35. HIGH SCHOOL GEOMETRY.
Non-credit course. SS.
This course may be used to satisfy the geometry prerequisite for Math. 50.
Elements of Euclidean geometry including congruence, parallel lines, circles, similar polygons, perimeters and areas, surface areas and volumes.

36. HIGH SCHOOL ALGEBRA.
Non-credit course. F. SS.
This course may be used to satisfy the third one-half unit of the high school algebra prerequisite for Math. 50.
Algebraic fractions, graphs, laws of fundamental operations, factors, linear equations, exponents and radicals, ratio-proportion-variation, logarithms, progressions, binomial theorem and inequalities.

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: S.S.S. F.
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.S.
Prerequisite: A.Gr. 45.
The origin and purpose of standards. Responsibility and importance 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. S.S.
Prerequisite: A.Gr. 46.
Linkages, screws, gears, pulleys and belts, and combinations of such mechanical elements. Methods of predicting displacements and accompanying velocities and accelerations. 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 non-ferrous 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.

83. TECHNICAL ELECTIVE.
Cr. 2 to 6 each time elected.
Elective material chosen with the advice and consent of the student's adviser. Electives must be chosen to provide background material for the student's design project.
502 Courses and Programs

97. ELECTRONIC SYSTEMS. (4-3) Cr. 5. W.
Prerequisite: 96.
Performance and function of electronic circuits in operational electronic systems.

99. SPECIAL TOPICS. (3-2) Cr. 4 each time elected.
Prerequisite: Permission of Instructor.

English

20, 21. ENGLISH COMPOSITION. (3-0) Cr. 3 each 20: F.W.; 21: W.S.
Prerequisite: 21: 20 or equivalent.
Principles of written composition, including grammar, mechanics, punctuation, vocabulary and sentence structure. Practice in expository writing.

40. LETTER AND REPORT WRITING. (3-0) Cr. 3. F.W.S.S.S.
Prerequisite: 21 or equivalent.
Discussion of form and layout of formal pieces of writing. Practice in formal presentation of material from technical projects.

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. 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 chosen by industrial plants and seminars to learn of career planning and position selection in engineering technology. 11: Inspection trips to nearby industrial plants and seminars to learn of engineering technician work chosen by industrial plants and seminars to learn of engineering technology.

14. TECHNICAL PROBLEMS I. (0-6) Cr. 2. F.W.
Prerequisite: Credit or classification in Math. 51.
Slide rule, Orderly solution of technical problems. Graphical techniques.

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. Cr. 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 elected.
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. (3-0) Cr. 3. F.W.S.S.S.
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.S.
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.
35. HIGH SCHOOL GEOMETRY.
Non-credit course. 8S.
This course may be used to satisfy the geometry prerequisite for Math. 50.
Elements of Euclidean geometry including congruence, parallel lines, circles, similar polygons, perimeters and areas, surface areas and volumes.

36. HIGH SCHOOL ALGEBRA.
Non-credit course. F. 8S.
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Algebraic fractions, graphs, laws of fundamental operations, factors, linear equations, exponents and radicals, ratio-proportion-variation, logarithms, progressions, binomial theorems and inequalities.

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.B.; 52: S.S.S.
F. Prerequisite: 50: One and one-half units of high school algebra and one unit of high school geometry; 51: 50 or equivalent; 52: 61 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.

Library

102. LIBRARY INSTRUCTION.
Cr. R. 5 weeks. W.
Use of libraries and books

Mathematics

35. HIGH SCHOOL GEOMETRY.
Non-credit course. 8S.
This course may be used to satisfy the geometry prerequisite for Math. 50.
Elements of Euclidean geometry including congruence, parallel lines, circles, similar polygons, perimeters and areas, surface areas and volumes.

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Non-credit course. F. 8S.
This course may be used to satisfy the third one-half unit of the high school algebra prerequisite for Math. 50.
Algebraic fractions, graphs, laws of fundamental operations, factors, linear equations, exponents and radicals, ratio-proportion-variation, logarithms, progressions, binomial theorem and inequalities.

40. BASIC MATHEMATICS.
(5-0) Cr. 5 W.
Algebra, including exponents and logarithms; basic mathematics of finance. Applications of statistics; graphs.

Technical Institute
504  Courses and Programs

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. SS.
Prerequisite: 85.
Fundamental concepts of fluid mechanics. Transmission and control of fluids in practical hydraulic systems.

90. MEASUREMENTS LABORATORY.  (1-6) Cr. 3. S. SS.
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.

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.
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

## 1872-1968

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<thead>
<tr>
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<td><strong>Baccalaureate Degrees (total)</strong></td>
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<td><strong>Professional Degrees</strong></td>
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| **All Degrees Conferred** | 2,567 | 66,754 | 2,766 | 69,520 |
# Summary of Enrollment

## ENROLLMENT 1966-67

A summary of different individuals enrolled during the year.

<table>
<thead>
<tr>
<th>Academic Year</th>
<th>Fiscal Year</th>
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<tbody>
<tr>
<td>Men</td>
<td>Women</td>
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<tr>
<td>Grand total of all students</td>
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<tr>
<td>Total of all students of college grade</td>
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<td>I  Students in residence of college grade</td>
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<td>College of Engineering</td>
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<td>College of Home Economics</td>
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<td>College of Sciences and Humanities</td>
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<td>College of Veterinary Medicine</td>
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<td>Graduate College</td>
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<tr>
<td></td>
<td>561</td>
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<tr>
<td>III  Students in residence not of college grade Music, driver training and nursery school</td>
<td></td>
</tr>
<tr>
<td></td>
<td>111</td>
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</table>

## ENROLLMENT 1967-68

A summary of different individuals enrolled during the year.

<table>
<thead>
<tr>
<th>Academic Year</th>
<th>Fiscal Year</th>
</tr>
</thead>
<tbody>
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<td>Men</td>
<td>Women</td>
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<td>Grand total of all students</td>
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<td>College of Engineering</td>
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<td>Technical Institute</td>
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<td>College of Home Economics</td>
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<td>College of Sciences and Humanities</td>
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<td>College of Veterinary Medicine</td>
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<td>Graduate College</td>
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<td>Total</td>
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<tr>
<td></td>
<td>140</td>
</tr>
<tr>
<td>III  Students in residence not of college grade Music, driver training and nursery school</td>
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### SUMMER QUARTER STUDENTS 1966

<table>
<thead>
<tr>
<th></th>
<th>First Term Only</th>
<th>Second Term Only</th>
<th>Twelve Weeks</th>
<th>Total</th>
<th>Summer and Academic Year</th>
<th>Students Attending Summer Only</th>
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</thead>
<tbody>
<tr>
<td>Grand Total of All Students</td>
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<td>1552</td>
<td>2098</td>
<td>5550</td>
<td>3972</td>
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<td>College of Veterinary Medicine</td>
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<td>Graduate College</td>
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<td>Music, driver training and nursery school</td>
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<td></td>
<td></td>
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</tr>
</tbody>
</table>

### SUMMER QUARTER STUDENTS 1967

<table>
<thead>
<tr>
<th></th>
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<th>Second Term Only</th>
<th>Twelve Weeks</th>
<th>Total</th>
<th>Summer and Academic Year</th>
<th>Students Attending Summer Only</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grand Total of All Students</td>
<td>1820</td>
<td>711</td>
<td>3568</td>
<td>6099</td>
<td>4434</td>
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<tr>
<td>Total of all students of college grade</td>
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<td>711</td>
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<td>5975</td>
<td>4434</td>
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