IOWA STATE UNIVERSITY OF SCIENCE AND TECHNOLOGY GENERAL CATALOG 1967/1969

IOWA STATE UNIVERSITY
FOUNDED 1858

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"One of the new imperatives of education, then, is to develop in young men and women the kind of mind and character which can make intelligent adjustment to revolutionary change."

President Parks
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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 the State Office Building, in Des Moines.

STATE BOARD OF REGENTS

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David A. Dancer, Executive Secretary

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Terms expire June 30, 1967

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Ned E. Perrin .................................... Mapleton
Stanley F. Redeker .................................. Boone

Terms expire June 30, 1969

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Mrs. Joseph F. Rosenfield ...................... Des Moines
Melvin H. Wolf .................................. Waterloo

Terms expire June 30, 1971

Casey Loss .................................. Algona
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Director of Purchasing and Stores

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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 approximately 35,000 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 1967 was in excess of $107 million, including $85 million owned by the University and the rest by affiliated organizations. The University's anticipated expenditure in 1966-67 was approximately $61 million, of which state appropriations provided about 35 percent. The remainder came from fees, contracts, sales, private gifts and grants, federal funds and endowment.
Main academic and residential campus, excluding most recreational areas, and outlying research areas.
FALL QUARTER 1967

September 4, Monday ................................... University Holiday, Offices Closed
September 6-10, Wednesday, 8 a.m. to Sunday .............. Orientation Days
September 7-8, Thursday and Friday 8 a.m.-4:30 p.m. .... Registration
September 8, Friday, 1-5 p.m. ................................ Examinations to Secure Advance Standing
or to Remove Incompletes
September 11, Monday ..................................... Class Work Begins
September 12, Tuesday, 4 p.m. ............................... End of Fee Payment Period
September 21, Thursday, 4 - 6 p.m. ......................... Senior and Graduate English Examination
October 13, Friday ............................................. Mid-quarter Reports Due
October 13, Friday ............................................. Final Date for Filing Diploma Cards
October 20-21, Friday p.m. and Saturday ............... Homecoming, Classes Dimissed at 12 noon Friday, Resume 12:10 p.m. Monday
October 27, Friday ............................................. Last Day Courses May Be Dropped
November 13, Monday ........................................ Examinations Begin
November 17, Friday .......................................... Examinations End
November 18, Saturday ....................................... Graduation
November 23, Thursday ...................................... University Holiday, Offices Closed

WINTER QUARTER 1968

November 27, Monday ...................................... Examinations to Secure Advance Standing or to
Remove Incompletes
November 27, Monday ...................................... Registration
November 28, Tuesday ...................................... Class Work Begins
November 29, Wednesday, 4 p.m. ............................ End of Fee Payment Period
December 7, Thursday, 4 - 6 p.m. ......................... Senior and Graduate English Examination
December 15, Friday, 6 p.m ................................. Christmas Recess Begins
December 23-26, Saturday through Tuesday .......... University Holidays, Offices Closed
January 1, Monday .............................................. University Holiday, Offices Closed
January 3, Wednesday, 7 a.m. ................................ Class Work Resumes
January 12, Friday ............................................. Mid-quarter Reports Due
January 12, Friday ............................................. Final Date for Filing Diploma Cards
February 2, Friday ............................................. Last Day Courses May Be Dropped
February 19, Monday .......................................... Examinations Begin
February 23, Friday ............................................. Examinations End
February 24, Saturday ........................................ Graduation

* Students in residence preceding quarter will register during the examination week of that quarter.
SPRING QUARTER 1968

March 4, Monday ........................................ Examinations to Secure Advance Standing or to Remove Incompletes
March 4, Monday* ........................................ Registration
March 5, Tuesday ........................................ Class Work Begins
March 6, Wednesday, 4 p.m. ........................ End of Fee Payment Period
March 14, Thursday, 4 - 6 p.m. ................ Senior and Graduate English Examination
April 5, Friday ........................................ Mid-quarter Reports Due
April 5, Friday ........................................ Final Date for Filing Diploma Cards
April 11, Thursday, 6 p.m. ........................ Easter Recess Begins
April 16, Tuesday, 7 a.m. ........................... Class Work Resumes
May 2, 3, 4, Thursday, Friday, Saturday . Peishe, Classes Dismissed 12 noon Thursday
May 3, Friday ........................................ Last Day Courses May Be Dropped
May 20, Monday ........................................ Examinations Begin
May 24, Friday ........................................ Examinations End
May 25, Saturday ...................................... Graduation
May 30, Thursday ...................................... University Holiday, Offices Closed

SUMMER QUARTER 1968

June 4, Tuesday ........................................ Registration
June 5, Wednesday ...................................... Class Work Begins
June 6, Thursday, 4 p.m. ............................ End of Fee Payment Period
June 13, Thursday, 4 p.m. ........................ Senior and Graduate English Examination
July 4, Thursday ........................................ University Holiday
July 12, Friday ........................................ First Session Ends
July 15, Monday ........................................ Registration
July 16, Tuesday ........................................ Class Work Begins
July 17, Wednesday, 4 p.m. ...................... End of Fee Payment Period
July 25, Thursday, 4 p.m. ........................ Senior and Graduate English Examination
August 22, Thursday ................................ Second Session Ends
August 23, Friday ...................................... Graduation

* Students in residence preceding quarter will register during the examination week of that quarter.
University Calendar / 1968 - 1969

FALL QUARTER 1968

September 2, Monday .......................... University Holiday, Offices Closed
September 4-8, Wednesday, 8 a.m. to Sunday ............................................. Orientation Days
September 5-6, Thursday and Friday 8 a.m. - 4:30 p.m. ......................... Registration
September 6, Friday, 1 - 5 p.m. ........ Examinations to Secure Advance Standing or to Remove Incompletes

September 9, Monday .................................... Class Work Begins
September 10, Tuesday, 4 p.m. ................. End of Fee Payment Period
September 19, Thursday, 4 - 6 p.m. ........ Senior and Graduate English Examination
October 11, Friday .................................. Mid-quarter Reports Due
October 11, Friday .................................. Final Date for Filing Diploma Cards
October 25-26, Friday p.m. and Saturday. . Homecoming, Classes Dismissed at 12 noon Friday, resume 12:10 p.m. Monday

November 8, Friday .............................. Last Day Courses May Be Dropped
November 18, Monday ............................ Examinations Begin
November 22, Friday ................................ Examinations End
November 23, Saturday ........................... Graduation
November 28, Thursday ......................... University Holiday, Offices Closed

WINTER QUARTER 1969

December 2, Monday ............................. Examinations to Secure Advance Standing or to Remove Incompletes

December 2, Monday* ................................ Registration
December 3, Tuesday ................................ Class Work Begins
December 4, Wednesday, 4 p.m. .................. End of Fee Payment Period
December 12, Thursday, 4 - 6 p.m. ........ Senior and Graduate English Examination
December 20, Friday, 6 p.m. ......................... Christmas Recess Begins
December 24-25, Tuesday-Wednesday .... University Holidays, Offices Closed
January 1, Wednesday ................................ University Holiday, Offices Closed
January 6, Monday, 7 a.m. .......................... Class Work Resumes
January 17, Friday ................................ Mid-quarter Reports Due
January 17, Friday ................................ Final Date for Filing Diploma Cards
February 7, Friday ................................... Last Day Courses May Be Dropped
February 24, Monday .............................. Examinations Begin
February 28, Friday ................................ Examinations End
March 1, Saturday .................................. Graduation

* Students in residence preceding quarter will register during the examination week of that quarter.
SPRING QUARTER 1969

March 10, Monday ........................................ Examinations to Secure Advance Standing or to Remove Incompletes
March 10, Monday* ........................................ Registration
March 11, Tuesday .......................................... Class Work Begins
March 12, Wednesday, 4 p.m. ............................. End of Fee Payment Period
March 20, Thursday, 4 - 6 p.m. ....................... Senior and Graduate English Examination
April 3, Thursday, 6 p.m. ................................. Easter Recess Begins
April 8, Tuesday, 7 a.m. .................................. Class Work Resumes
April 11, Friday ............................................. Mid-quarter Reports Due
April 11, Friday ............................................. Final Date for Filing Diploma Cards
May 1, 2, 3, Thursday, Friday, Saturday .......... Veishea, Classes Dismissed 12 noon Thursday
May 9, Friday ................................................ Last Day Courses May Be Dropped
May 19, Monday ............................................. Examinations Begin
May 23, Friday ............................................. Examinations End
May 24, Saturday ........................................... Graduation
May 30, Friday .............................................. University Holiday, Offices Closed

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SUMMER QUARTER 1969

June 3, Tuesday .......................................... Registration
June 4, Wednesday ........................................ Class Work Begins
June 5, Thursday, 4 p.m. ............................... End of Fee Payment Period
June 12, Thursday, 4 p.m. ......................... Senior and Graduate English Examination
July 4, Friday ............................................. University Holiday, Offices Closed
July 11, Friday .......................................... First Session Ends
July 14, Monday .......................................... Registration
July 15, Tuesday ........................................... Class Work Begins
July 16, Wednesday, 4 p.m. ............................. End of Fee Payment Period
July 24, Thursday, 4 p.m. .............................. Senior and Graduate English Examination
August 21, Thursday ................................... Second Session Ends
August 22, Friday ........................................ Graduation

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

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

W. ROBERT PARKS, President; Professor of Government
B.A., 1937, Berea; M.A., 1938, Kentucky; Ph.D., 1948, Wisconsin

R. SCOTT ALLEN, Professor of Biochemistry; Professor of Animal Science; Charles F. Curtiss Distinguished Professor in Agriculture
B.S., 1939, M.S., 1940, Brigham Young; Ph.D., 1949, Iowa State

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

WAYNE E. ALMQUIST, Instructor in English
B.A., 1957, Nebraska

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

JOHN R. ANDERSEN, Assistant Professor of Veterinary Microbiology and Preventive Medicine
D.V.M., 1959, M.S., 1965, Iowa State

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

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

DON M. ANDERSON, Professor of Foreign Languages

EDWARD E. ANDERSON, Instructor in Mechanical Engineering
B.S., 1964, Iowa State

ERNEST W. ANDERSON, 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

GLENDON R. ANDERSON, Assistant Professor of Physical Education for Men; Head Basketball Coach
B.S., 1951, Colorado State
IRVIN C. ANDERSON, Associate Professor of Agronomy; Associate Professor of Botany
B.S., 1951, Iowa State; M.S., 1954, Ph.D., 1957, North Carolina State

JACK M. ANDERSON, Assistant Professor of Mathematics
B.S., 1953, South Dakota; M.S., 1954, Ph.D., 1959, Iowa State

JANICE M. ANDERSON, Instructor in Applied Art

KATHERINE K. ANDERSON, Instructor in Home Economics Education
B.S., 1963, Nebraska

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

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

MARVIN A. ANDERSON, 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

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

RUSSELL D. ANDERSON, Instructor in Electrical Engineering
B.S. (E.E.), 1960; B.S (M.E.), 1961, M.S., 1964, Iowa State

SHARON C. ANDERSON, Instructor in English
B.S., 1964, Iowa State

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

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

THOMAS K. ANDISON, Instructor in Industrial Administration

FLOYD ANDRE, 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

MARY JANE ANDREWS, Instructor in English
B.A., 1959, State College of Iowa; M.S., 1965, Iowa State

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

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

LOREN H. APPELL, Instructor in Veterinary Pathology
D.V.M., 1966, Iowa State

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

PETER L. ARCUS, Associate, Economics
M.Sc., 1964, Massey (New Zealand)

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

BARRY C. ARNOLD, Assistant Professor of Mathematics; Assistant Professor of Statistics
Ph.D., 1965, Stanford

CAROLE R. ARNOLD, Instructor in Child Development; Instructor in Psychology

JOHN M. ARNOLD, Assistant Professor of Zoology
B.A., 1958, Ph.D., 1963, Minnesota

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

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

SAM ARONOFF, Professor of Biochemistry
A.B., 1936, Ph.D., 1942, California (Berkeley)
I. W. ARTHUR, Professor of Economics
B.S., 1916, M.S., 1927, Iowa State; Ph.D., 1939, Minnesota

RICHARD E. ATKINS, Professor of Agronomy
B.S., 1941, Kansas State; M.S., 1942, Ph.D., 1948, Iowa State

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

ACHILLES AVRAAMIDES, Instructor in History

MARVIN K. AYCOCK, JR., Associate, Agronomy
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B.A., 1963, Iowa

Marilyn D. Bachmann, Associate, Genetics
B.S., 1955, Ball State; M.A., 1960, Ph.D., 1964, Michigan

Roger W. Bachmann, Assistant Professor of Fisheries Biology
B.S., 1956, Ph.D., 1962, Michigan, M.S., 1958, Idaho

Donald M. Bailey, Instructor in Metallurgy
B.S., 1954, Illinois State; M.S., 1961, Iowa State

Merritt E. Bailey, Jr., Assistant Professor of Technical Journalism; Director of Book Publishing
B.S., 1949, M.S., 1951, Iowa State

Durwood L. Baker, Professor of Veterinary Medicine and Surgery; Assistant Dean of the College of Veterinary Medicine
D.V.M., 1943, Iowa State

Harlan K. Baker, Assistant Professor, Engineering Extension
B.S., 1963, Iowa State

Harold D. Baker, Assistant Professor of Statistics
B.S., 1958, M.S., 1963, Iowa State

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

Louis N. Baker, Associate Professor of Animal Science
B.S., 1950, New Hampshire; M.S., 1951, Kentucky; Ph.D., 1954, Wisconsin

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

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

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

Roger A. Ball, Associate Professor of Veterinary Pathology
D.V.M., 1954, Iowa State, Ph.D., 1964, Minnesota

Charles R. Ballantyne, Associate Professor of Agronomy
B.A., 1930, M.A., 1931, Iowa

Stanley L. Baloune, Professor of Poultry Science
B.S., 1930, Ph.D., 1952, Iowa State

Dale R. Balmer, Associate, Assistant Supervisor, WOI-TV

Theodore A. Bancroft, Professor of Statistics and Head of the Department; Director of the Statistical Laboratory
A.B., 1927, Florida; A.M., 1934, Michigan; Ph.D., 1943, Iowa State

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

Dwight M. Bannister, Associate Professor, Assistant Extension Editor, Cooperative Extension Service
B.S., 1928, Northwestern

Paul W. Barcus, Assistant 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
RICHARD G. BARNES, Professor of Physics

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

PATRICIA G. BARNETT, Instructor, Home Economics Administration
B.S., 1964, M.S., 1965, Iowa State

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

WAYNE H. BARTZ, Assistant Professor of Psychology

JOHN P. BASART, Instructor in Electronics Technology
B.S., 1962, M.S., 1963, Iowa State

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

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

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

WARD W. BAUDER, Professor of Sociology
B.S., 1936, M.S., 1938, Nebraska, Ph.D., 1948, Cornell

E. ROBERT BAUMAN, Professor of Civil Engineering
B.S.E., 1944, Michigan; B.S., 1945, M.S., 1947, Ph.D., 1954, Illinois

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

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

HOWARD T. BAUSUM, Assistant Professor of Genetics
B.S., 1954, Carson-Newman; M.S., 1956, Tennessee; Ph.D., 1964, Texas

ALLEN B. BEACH, Instructor in Chemical Engineering
B.S., 1961, Iowa State

GEORGE M. BEAL, Professor of Sociology
B.S., 1943, M.S., 1947, Ph.D., 1953, Iowa State

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

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

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

BARBARA J. BECK, Instructor in Physical Education for Women
B.S., 1965, Illinois

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

RUSSELL J. BEERS, Associate Professor of Bacteriology
B.S., 1933, M.S., 1935, Nebraska; Ph.D., 1956, Illinois

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

THOMAS A. BEINKE, Instructor in Chemistry
B.S., 1961, Ohio, Ph.D., 1966, California Institute of Technology

HOWARD BELL, Assistant Professor of Nuclear Engineering
B.S., 1958, M.S., 1960, Ph.D., 1966, California (Berkeley)

EDWARD A. BENBROOK, Professor of Veterinary Pathology; Clarence Hartley Covault Distinguished Professor in Veterinary Medicine
V M.D., 1914, Pennsylvania

RAYMOND R. BENEKE, Professor of Economics
B.S., 1940, M.S., 1946, Iowa State; Ph.D., 1949, Minnesota

CHARLES L. BENN, Associate; Photographer, Cooperative Extension Service
PAUL C. BENNETT, Professor of Veterinary Pathology  
B.S., M.S., 1923, West Virginia; D.V.M., 1931, Ohio State

DWIGHT W. BENSEN, Professor of Forestry  
B.S., 1937, Ph.D., 1942, Minnesota

DONALD R. BENSON, Associate Professor of English  
A.B., 1949, Kansas City, M.A., 1951, Colgate; Ph.D., 1959, Kansas

JAMES E. BENSON, Associate, Institute for Atomic Research  
B.S., 1960, Hillsdale; M.S., 1963, Iowa State

MICHAEL F. BERARD, Instructor in Ceramic Engineering; Associate, Institute for Atomic Research  
B.S., 1960, M.S., 1962, Iowa State

HOBART BERESFORD, Professor of Agricultural Engineering  
B.S., 1924, A.E., 1941, Iowa State

REX BERESFORD, Professor Emeritus of Animal Science  
B.S.A., 1911, Iowa State

CAROLE B. BERNARD, Instructor in English  
B.A., 1962, Southwest Louisiana

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WILLIAM D. DAVIDSON, Director
MARJORIE D. WARNER, Home Economist

BOONE COUNTY, Boone
T. N. NELSON, Director
DEAN M. KING, Associate
EVELYN M. RUEHR, Assistant

BREMER COUNTY, Tripoli
PEARL E. PARDEE, Home Economist
KERMIT J. HILLDAHL, Associate

BUCHANAN COUNTY, Independence
JAY I. PARTRIDGE, Director
GENE R. MCBRIDE, Associate
JUDITH G. SANDIN, Assistant

BUENA VISTA COUNTY, Storm Lake
JAMES D. NUSS, Director
RONALD D. IRVIN, Associate

BUTLER COUNTY, Allison
KAY A. CONNELLY, Director
ROBERTA R. RECKLER, Assistant

CALHOUN COUNTY, Rockwell City
W. HAL SPEERS, Director
YVONNE W. THUROW, Home Economist

CARROLL COUNTY, Carroll
ROLAND F. LICKTEIG, Director
LUCILE BUCHANAN, Home Economist
W. ROBERT MILLENDER, Associate

CASS COUNTY, Atlantic
A. DANIEL MERRICK, Director
LAVON M. EBLEN, Home Economist
LOUISE M. SORENSEN, Assistant

CEDAR COUNTY, Tipton
KENNETH D. MULLER, Director
R. KENNETH LEE, Assistant

CERRO GORDO COUNTY, Mason City
SPENCER G. WILLIAMS, Director

CHEROKEE COUNTY, Cherokee
FORREST J. KOHRT, Director
THEDA N. SCOTT, Home Economist
CHESTER C. BENSON, Associate

CHICKASAW COUNTY, New Hampton
GERALD K. ANDERSON, Director
SHARON H. BELL, Home Economist

CLARKE COUNTY, Osceola
WILLIAM F. SHORT, Director
LILLIAN K. PRICE, Home Economist

CLAY COUNTY, Spencer
WAYNE R. HANSEN, Director
LOLA A. ROBINSON, Home Economist

CLAYTON COUNTY, Elkader
MAX E. SAUERBRY, Director
EVELYN THIELE, Home Economist
JAMES C. HOSCH, Associate

CLINTON COUNTY, DeWitt
NORMAN J. GOODWIN, Director
HELEN WHITTINGTON, Home Economist

*HAROLD L. CRAIG, Leader, 4-H and Youth Programs

DECATUR COUNTY, Leon
GEORGE F. PEISEN, Director

DAVIS COUNTY, Bloomfield
WILLIAM D. BYERS, Director
ESTHER L. HUBBARTT, Home Economist

*HAROLD L. CRAIG, Leader, 4-H and Youth Programs

EUGENE J. CARROLL, Associate
LINN COUNTY, Cedar Rapids  
C. E. HERRIOTT, Director  
GRACE DRENKHAHN, Home Economist  
THOMAS A. MCCAUGHAN, Associate  
LOUISA COUNTY, Wapello  
GAYLORD D. ELLIOTT, Director  
LUCAS COUNTY, Chariton  
JOE D. MILLER, Director  
LYON COUNTY, Rock Rapids  
ROGER A. BALDWIN, Director  
ELEANOR L. LADD, Home Economist  
MADISON COUNTY, Winterset  
HENRY I. STUCHEL, JR., Director  
MAHASKA COUNTY, Oskaloosa  
EUGENE L. REISSETTER, Director  
*JOHN W. PATTERSON, Associate  
MARION COUNTY, Knoxville  
RICHARD T. FREEMAN, Director  
*RUTH S. ARCHIBALD, Home Economist  
MARRSHALL COUNTY, Marshalltown  
DONALD G. HARMAN, Director  
GRETA W. BOWERS, Home Economist  
MILLS COUNTY, Malvern  
LAVERNE C. OBRECHT, Director  
WILMA L. SCHULTZ, Home Economist  
MITCHELL COUNTY, Osage  
EDGAR W. DOROW, Director  
*MAY JOHNON, Associate  
MONONA COUNTY, Onawa  
LARRY D. DUVAL, Director  
LETTIE B. THRIFT, Home Economist  
MONROE COUNTY, Albia  
JAMES D. JOHNSON, Director  
*MARGARET H. MORDAN, Home Economist  
MONTGOMERY COUNTY, Red Oak  
STANLEY L. DUNN, Director  
MUSCATINE COUNTY, Muscatine  
EUGENE MATHERN, Director  
O'BRIEN COUNTY, Primghar  
JOHN H. LONGSTREET, Director  
ETHEL N. OLDAKER, Home Economist  
OSCEOLA COUNTY, Sibley  
RAYMOND DIRKSEN, Director  
PAGE COUNTY, Clarinda  
JOHN E. RYDEL, Director  
MARJORIE B. BURCH, Home Economist  
*CAROLYN A. CARLSON, Associate  
PALO ALTO COUNTY, Emmetsburg  
HAROLD H. HEYKES, Director  
*MARGARET D. PRATT, Home Economist  
PLYMOUTH COUNTY, LeMars  
LYLE R. MACKAY, Director  
DUANE R. BUEHLER, Associate  
POCAHONTAS COUNTY, Pocahontas  
ALVIN M. ANDERSON, Director  
RONALD L. ORTH, Associate  
POLK COUNTY, Des Moines  
GROVER H. HAHN, Director  
BEATRICE J. BROCK, Home Economist  
C. DANORA WATERHOUSE, Associate  
OBER J. ANDERSON, Associate  
POTAWATTAMIE COUNTY, EAST, Oakland  
DOYLE R. WOLVERTON, Director  
RAY O. OELKERS, Associate  
POTAWATTAMIE COUNTY, WEST, Council Bluffs  
J. CLIFFORD JOHNSON, Director  
CAROL ANN HAHN, Home Economist  
DALE G. SHIRES, Associate  
RAYMOND E. WAGNER, Associate  
POWESHEIK COUNTY, Montezuma  
GARY M. PETERSON, Director  
KATHRYN S. WEMER, Home Economist  
RINGGOLD COUNTY, Mount Ayr  
J. NEIL CHICKEN, Director  
SAC COUNTY, Sac City  
K. R. LITTLEFIELD, Director  
FLOYD SCHRIRING, Associate  
H. ELIZABETH BLOCK, Assistant  
SCOTT COUNTY, Davenport  
DONALD P. OLSON, Director  
LETTIE E. ZUBER, Home Economist  
W. EARL WEAR, Assistant  
SHELBY COUNTY, Harlan  
DALE C. SEEBACH, Director  
CLEDA F. DANIALS, Home Economist  
SIOUTH COUNTY, Orange City  
MAURICE E. ELDRIDGE, Director  
BEVERLY A. GREEN, Home Economist  
HERBERT E. DODDS, Assistant  
STORY COUNTY, Nevada  
JAMES R. CHRISTY, Director  
SANDRA H. HORTON, Home Economist  
TAMA COUNTY, Toledo  
G. GRESS ROGERS, Director  
MINA S. OLIN, Home Economist  
MAURICE E. SUTTON, Assistant  
TAYLOR COUNTY, Bedford  
RONALD C. SANSON, Director  
HELEN M. MEYERS, Home Economist
UNION COUNTY, Creston
STEVE A. EVANS, Director
DOROTHY E. BARTLESON, Home Economist
* JAMES F. KEARNS, Associate

VAN BUREN COUNTY, Keosauqua
MELVIN L. POWERS, Director
EDNA C. MORRIS, Home Economist

WAPELLO COUNTY, Ottumwa
DALE M. UEHLING, Director
DORCAS L. WHEATLEY, Home Economist

WARREN COUNTY, Indianola
MARVIN L. SMART, Director
BERTHA MAE KELLY, Home Economist

WASHINGTON COUNTY, Washington
JAMES R. FRIER, Director
SALLY J. SMITH, Home Economist

WAYNE COUNTY, Corydon
F. WAYNE HART, Director
* DONALD A. LUSCH, Associate

WEBSTER COUNTY, Fort Dodge
JAMES C. ALMQUIST, Director
VERLA B. ULISH, Home Economist

WINNEBAGO COUNTY, Thompson
RICHARD W. ANDERSON, Director
MARY JANE HOLLAND, Home Economist

WINNESHIEK COUNTY, Decorah
E. J. WEIGLE, Director
MARY JANE OSLAND, Home Economist
JOHN J. RODECAP, Associate

WOODBURY COUNTY, Sioux City
ROBERT Heglund, Director
ESTHER MCKEE, Home Economist
EDWARD E. NEVEN, Associate
JANET E. ADKINS, Assistant

WORTH COUNTY, Northwood
NEIL E. BULMAN, Director
FLORENCE FERDEN, Home Economist

WRIGHT COUNTY, Clarion
ROBERT F. BERNHARDT, Director
GERALDINE S. STEELE, Home Economist
WILLIAM D. SUNDELL, Assistant

* Has multi-county responsibility
COOPERATIVE EXTENSION SERVICE AREA FIELD STAFF

EXTENSION AREA OFFICES
CEDAR RAPIDS - 852 A. Avenue, NE
VIVAN M. JENNINGS, Extension Leader, Crop Production
LESLIE G. KRAL, Extension Leader, Farm Management
HENRIETTA VANMAANEN, Extension Home Economist

OTTUMWA - Industrial Airport
DARREL L. GRICE, Extension Leader, Area Development
RICHARD J. MIKES, Extension Leader, Business Management
ALLAN L. SEIM, Extension Leader, Crop Production
DONALD M. GEE, Extension Leader, Farm Management
CLIFFORD I. IVERSON, Extension Leader, Livestock Production

SPENCER -
DEAN L. BARNES, Extension Leader, Crop Production
W. J. TURNER, Extension Leader, Farm Management

OTHER AREA STAFF MEMBERS
EXTENSION LEADERS, AREA DEVELOPMENT
MARTIN T. POE, JR., Mason City
RONALD C. FAAS, Creston
CLARENCE E. RICE, Fort Dodge

EXTENSION LEADERS, CROP PRODUCTION
KYLE R. PETERSON, Denison
VIRGIL K. WEBSTER, Manchester
GARREN O. BENSON, Mt. Pleasant
CLARENCE E. BABCOCK, Fort Dodge

EXTENSION LEADERS, FARM MANAGEMENT
ERROL D. PETERSEN, Atlantic
JAMES E. HUGHES, Fort Dodge
L. J. BODENSTEINER, Decorah

EXTENSION LEADER, 4-H AND YOUTH
MILTON HENDERSON, Mount Ayr
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 pre-eminence 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, 1966, there were 2,291 graduates.

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 AND SESSIONS

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 1967 Iowa State had an enrollment of more than 15,000 and a faculty which numbered more than 1,400.
CURRICULA AND PROGRAMS

The University is organized into six 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 Education
- Agricultural Engineering
- Agricultural Communication
- Agronomy
- Animal Science
- Dairy Industry
- Dairy Science
- Entomology
- Farm Operation
- Fisheries and Wildlife Biology
- Food Technology
- Forestry
- Horticulture
- Industrial Education
- Landscape Architecture
- Plant Pathology
- Poultry Science
- Resource Development for Outdoor Recreation
- Urban Planning

Leading to a Certificate in Technical Agriculture:

- Agricultural Business
- Agronomy
- Animal Science
- Dairy Science

Leading to a Certificate of Completion:

- Winter Quarter Program in Farm Operation

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 Architecture:

- Architecture

COLLEGE OF HOME ECONOMICS

Leading to the degree Bachelor of Science:

- Applied Art
- Child Development
- Child Development—Elementary Education
- Food and Nutrition
- Home Economics Education
- Home Economics for General Education
- Home Economics Journalism
- Household Equipment
- Institution Management
- Physical Education for Women
- Textiles and Clothing
COLLEGE OF SCIENCES AND HUMANITIES

Leading to the degree Bachelor of Science:

- Bacteriology
- Biochemistry
- Biophysics
- Botany
- Chemistry
- Distributed Studies
- Earth Science
- Economics
- English and Speech
- Genetics
- Government
- History
- Industrial Administration
- Mathematics
- Metallurgy
- Music
- Foreign Languages
- Naval Science
- Philosophy
- Physical Education for Men
- Physical Education for Women
- Physics
- Psychology
- Sociology
- Statistics
- Science Journalism
- Zoology

COLLEGE OF VETERINARY MEDICINE

Leading to the degree Doctor of Veterinary Medicine:

- Veterinary Medicine

THE TECHNICAL INSTITUTE

Leading to the Associate Diploma:

- Agriculture
- Food Service Management
- Chemical Industries Technology
- Electronics Technology
- Construction Technology
- Mechanical Technology

GRADUATE COLLEGE

The Graduate College confers the degrees Master of Architecture, Master of Education, Master of Engineering, 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 State College of Iowa and the University of Iowa.

HONORS PROGRAM

Students of high ability will find the University Honors Program provides a maximum educational opportunity and will give formal recognition to their special accomplishments and special responsibilities.
Each college has its own Honors Program within the general outline of the University Honors Program. All are highly individualized. They are planned to provide the widest range of opportunity corresponding to the needs, interests and aptitudes of the individual student. Each student's program is developed with the aid of faculty advisers within the college in which he is enrolled.

A program may permit, among other things:

- Waiving of certain requirements for graduation (except for fixed total number of hours required)
- Waiving of prerequisites (whenever the action appears reasonable) to permit students in Honors Programs to take more advanced courses than ordinarily would be allowed.

Students in any undergraduate curriculum at Iowa State are eligible to participate in the Honors Program.

During the third quarter of residence, or at any time thereafter, a student who has a cumulative grade point average of 3.5 or above may apply to the Honors Program Committee of his college for entrance into the Honors Program. A student who has demonstrated exceptionally high ability, but who has not achieved the minimum requirements for entrance into the program, may be admitted if he is recommended by the dean of his college.

Chairman of the University Honors Program Committee is Dr. Edwin C. Lewis.
RESEARCH AND SERVICE AGENCIES

Research plays a large role at Iowa State. Most faculty 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 $22 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
George M. Browning, Ph.D., Associate Director
Helen R. LeBaron, Ph.D., Assistant Director
John P. Mahlstede, 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 dozens of 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

RESIDENT COLLABORATORS

A collaborator is a person working on an active experiment station project whose salary is paid directly by some agency other than Iowa State University and who does not have academic rank.

Agriculture Research Service, USDA

Ben Bereskin
Raymond L. Clark
Steve A. Eberhart

Arnel R. Hallauer
Walter Lovely
J. L. Schmidt
The University

ENGINEERING RESEARCH INSTITUTE
David R. Boylan, Ph.D., Director

Organized in 1904 to conduct investigations on engineering problems and to promote industrial development of the state, the Engineering Research Institute is the research arm of the College of Engineering.

Research is supported by state appropriations, and industrial and government research grants and contracts. Major research facilities include an aerodynamic shock tube, x-ray and infra-red spectrophotometers, an electrical network analyzer, 10 kw nuclear reactor, an electron microscope, a nationally recognized soils research laboratory and bituminous research laboratory and various engineering shops.

The Institute undertakes research in the fields of architectural, agricultural, aerospace, ceramic, chemical, civil, electrical, industrial, mechanical and nuclear engineering, and in the areas of:

- aerodynamics
- agricultural by-products
- biomedical engineering
- ceramics
- computers
- electronics
- energy conversion
- extraction
- filtration
- fluids
- highways
- ion exchange
- materials
- metallurgy
- nucleonics
- operations analysis
- process development
- sanitation
- semi-conductors
- similitude
- soils
- structures
- valuation
- wave propagation

The major research personnel of the station are active also in teaching, and a large part of the research activities is related directly to graduate instruction and training. Research projects generally are initiated and supervised by the staff.

SCIENCE AND HUMANITIES RESEARCH INSTITUTE
Chalmer J. Roy, Ph.D., Director

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

Research is conducted in the fields of:

- bacteriology
- biochemistry
- biophysics
- botany
- chemistry
- computer science
- earth science
- economics
- English
- foreign languages
- government
- history
- industrial administration
- mathematics
- music
- philosophy
- physics
- psychology
- sociology
- speech
- statistics
- zoology

COMPUTATION CENTER
C. G. Maple, D.Sc., Director
R. M. Stewart, Ph.D., Associate Director
C. C. Mosier, B.S., Assistant Director

The Computation Center was organized in 1962 to provide an all-university computing service and a centralized facility for research and education in the computer sciences.

University staff members and students having problems suited for digital computation can use the computing service as well as a consulting 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.

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

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

The Laboratory cooperates closely with research workers in all colleges of the University. Staff and facilities are maintained for statistical consulting aid, numerical analysis and programming, 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.

INSTITUTE FOR ATOMIC RESEARCH
Frank H. Spedding, Ph.D., LL.D., D.Sc., Director
Morton Smutz, Ph.D., Deputy Director
Adolf F. Voigt, Ph.D., Assistant Director

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 turning the process 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 promotion of a vital war material.

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

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

- To build up 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, engineering and biology, which are naturally associated with these fields.
- To have available on the campus a group of experts in these newer developments so other members of the faculty can consult them concerning the application of these new tools to their own problems.
- To encourage cooperation and coordination in this type of research work on the campus on a voluntary basis. Particular emphasis is placed on borderline fields between the several sciences where expert advice is needed from several different fields.
- To carry out research whereby graduate students may obtain the specialized knowledge and skills which they will need in order to do independent research in these fields. The formal course work is given and degrees awarded through the several departments and colleges.
AMES LABORATORY OF THE UNITED STATES
ATOMIC ENERGY COMMISSION

Frank H. Spedding, Ph.D., LL.D., D.Sc., Director
Morton Smutz, Ph.D., Deputy Director
Adolf F. Voigt, Ph.D., Assistant Director
George Burnet, Ph.D., Division Chief in Chemical Engineering
R. S. Hansen, Ph.D., Division Chief in Chemistry
Clair G. Maple, Ph.D., Division Chief in Mathematics and Computer
W. H. McCorkle, Ph.D., Chief, Reactor Division
John F. Smith, Ph.D., Division Chief in Metallurgy
D. J. Zaffarano, Ph.D., Division Chief in Physics
D. R. Wilder, Ph.D., Division Chief in Ceramic and Mechanical Engineering

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.

VETERINARY MEDICAL RESEARCH INSTITUTE

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

Operated as a part of the College of Veterinary Medicine, the Veterinary Medical Research Institute carries on cooperative research with other departments of the University, particularly Bacteriology, Animal Science, Poultry Science, Zoology and Food and Nutrition. Its quarters include laboratories and isolation facilities for experimental animals south of campus. Research is also conducted in campus laboratories.

Emphasis is placed on diseases of greatest consequence to the livestock industry of Iowa. Frequent conferences are held with veterinarians in general practice in order to identify these problems.
IOWA VETERINARY MEDICAL DIAGNOSTIC LABORATORY

Vaughn A. Seaton, D.V.M., M.S., Head

Primary purpose of the Iowa Veterinary Medical Diagnostic Laboratory is to provide technical service to veterinarians and others within the state in the diagnosis of animal diseases. The Laboratory annually receives thousands of specimens from all parts of Iowa for examination. It cooperates closely with the state and federal disease control programs and public health agencies. In addition, it serves as a teaching laboratory for both undergraduate and graduate students in the College of Veterinary Medicine.

VETERINARY MEDICAL CLINICS

Wallace M. Wass, D.V.M., Ph.D., Head

Veterinary clinics at Iowa State include medical, surgical, obstetrical and radiological clinics for large and small animals. The department also operates an ambulatory clinic service which makes calls to farms in the general area of Ames. Junior and senior students are required to spend several hours each day in the clinics working under the supervision of the clinic staff and assisting in the diagnosis, care and treatment of sick and injured animals. Close liaison is maintained with the other teaching departments of the College of Veterinary Medicine such as Anatomy, Physiology, Microbiology and Preventive Medicine, Pathology and the Diagnostic Laboratory which also contribute to the clinic training program.

WATER RESOURCES RESEARCH INSTITUTE

Don Kirkham, Ph.D., Director
J. B. Page, Ph.D., Administrative Adviser

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

CENTER FOR AGRICULTURAL AND ECONOMIC DEVELOPMENT

Earl O. Heady, Ph.D., Executive Director

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

The Center tries to help all people 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 stability.

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 also the alternative policies that can be applied to solve these problems.

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 open in meeting those problems.

Help to the Land-Grant universities to modify their organization and programs in order to assist people to cope with the rapidly-changing needs of the times.

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.
UNIVERSITY EXTENSION

Marvin A. Anderson, Ph.D., Dean

University Extension was established March 1, 1966, by the inclusion in a single administrative unit of four service groups which had previously operated separately.

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

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

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

Cooperative Extension Service in Agriculture and Home Economics

Marvin A. Anderson, Ph.D., Director

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

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

The University was charged with its present responsibilities in Cooperative Extension by action of the state legislature in 1906. In 1914 Congress passed the Smith-Lever Act which provided for Cooperative Extension work in the Land-Grant College system. The United States Department of Agriculture, the University, county governments and local organized groups are cooperators in this enterprise. Financial support comes from state, federal, and county appropriations.
Engineering Extension
R. E. Patterson, Jr., B.S., Director

Established at Iowa State in 1913 by the Iowa General Assembly, Engineering Extension is supported by fees from participants, by state appropriations and by certain federal funds.

"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 ISU 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.

Short Courses

George H. Ebert, M.S., Short Course Leader

Short courses and continuing education programs are offered as part of the broad educational and service base of Iowa State University.

The primary purpose is to assist in providing educational experiences for off-campus groups by bringing them together with faculty members and other qualified individuals in a learning situation.

The Short Course Office provides assistance in the initiation, planning, operation and administration of continuing education programs and services.

A Short Course Bulletin is published quarterly and may be obtained by writing the Short Course Leader, Curtiss Hall. Before the opening of each course, information regarding rooms, registration, location of meeting, study program and speakers is available.

Distribution of short courses from 1964 to 1966 was:

<table>
<thead>
<tr>
<th>College of Agriculture</th>
<th>81</th>
<th>84</th>
<th>16,063</th>
<th>16,655</th>
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<tbody>
<tr>
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<td>64</td>
<td>59</td>
<td>4,587</td>
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<tr>
<td>College of Home Economics</td>
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</tr>
<tr>
<td>College of Veterinary Medicine</td>
<td>8</td>
<td>6</td>
<td>259</td>
<td>195</td>
</tr>
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<td>166</td>
<td>158</td>
<td>22,941</td>
<td>23,288</td>
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</tbody>
</table>
Admission and Registration

Arthur M. Gowan, Ph.D., Dean of Admissions and Records
Wayne A. DeVaul, B.S., Director of Admissions
Fred C. Schlunz, M.S., Registrar
John W. Pace, M.A., Assistant to the Dean of Admissions and Records
Don F. Gustafson, B.S., Associate Director of Admissions
Karsten Smedal, B.S., Assistant Director of Admissions
Maurice Geist, M.A., Assistant Director of Admissions
John V. Sjoblom, M.A., Associate Registrar
Dean Nelson, M.A., Assistant to the Registrar

Application for admission to Iowa State University may be made by writing to the Director of Admissions, 104 Beardshear Hall, Iowa State University, Ames, Iowa. 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 Beardshear Hall, is open Monday through Friday from 8 a.m. to 11:50 a.m. and from 1 p.m. to 5 p.m. and on Saturdays forenoons from 8 until 11:50. 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, 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 session, or (4) be denied admission.

2. A graduate of an accredited high school in another state must meet at least the same standards as a graduate of an Iowa high school. The options for admission by probation or tryout enrollment may not be open to these students. Each college reserves the right to demand higher standards from graduates of out-of-state high schools.
3. A graduate of 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 (2.00 based on an "A" grade being 4 points) for all college work previously attempted and not be under suspension from the last college attended. Students from non-accredited colleges or universities 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.

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 terms 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 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 RESIDENTS AND NON-RESIDENTS FOR ADMISSION AND FEE PURPOSES

1. General

Students shall be classified as Resident or Non-resident for admission, fee, and ...
tuition purposes by the Registrar. The
decision shall be based upon information
furnished by the student and all other
relevant information. The Registrar is
authorized to require such written docu-
ments, affidavits, verifications, or other
evidence as are deemed necessary to es-

tablish the domicile of a student, including
proof of emancipation, adoption, award
of custody, or 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-resi-
dent classifications, the word "parents" as
herein used shall include legal guardians
or others standing	as are deemed
necessary as are deemed
necessary to esti-

2. Residence for Tuition Purposes
Regulations regarding residence for ad-
mission, fee and tuition payments 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 re-
quirements in these categories are dif-
ferent. Domicile within the state means
adoption of the state as a fixed perma-
nent 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 unmarried or un-
emancipated minor; but if the father and
the mother have separate places of resi-
dence, 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 had domicile
within the state for six months immedi-
ately prior to the date of the minor's
enrollment at Iowa State University.

A minor admitted before his parents
have moved to Iowa or before they have
been here six months, may be re-classi-
fied as a resident at the next registration
after his parents have had a domicile
here six months.

A minor student whose parents move
their residence from Iowa to a location
outside of Iowa shall be considered to be
a non-resident after six months from the
date of the parents' removal from the
state.

In the event that the fact of non-resident
emancipation is established, the emanci-
pated minor assumes all of the respon-
sibilities of an adult and must establish
residence for tuition purposes by main-
taining his residence within the state for
12 consecutive months while not in school,
the same as in the case of any other
non-resident adult.

4. Students Over 21 Years of Age
A resident student 21 years of age or
over is one (1) whose parents were resi-
dents of the state at the time he reached
his majority and who has not acquired
a domicile in another state, or (2) who,
while an adult, has established a bona
fide residence in the state of Iowa by
residing in the state for at least 12 con-
secutive 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 while a student at
any school or college does not by virtue
of such fact attain residence in this state
for admission or tuition payment pur-
poses.

5. General Facts
The residence of a wife is that of her
husband. A non-resident female student
may attain residence through marriage,
and correspondingly, a resident female
student may lose residence by marrying
a non-resident. Proof of marriage should
be furnished to the Registrar at the time
change of status is requested.

Persons who are moved into the state
as the result of military or civil orders
from the government, or the minor chil-
dren of such persons, are entitled to
residence status after residing in Iowa
for six months. However, if the initial
registration of the minor children pre-
cedes the arrival of the parents, non-
resident tuition will be charged in all
cases until the next registration after the
conditions set forth above are met.

Dependents of persons whose legal resi-
dence is permanently established in Iowa,
who have been classified as residents for
tuition purposes may continue to be clas-
sified as residents so long as such resi-
dence is maintained, even though circum-
stances 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
provide proof of a legal Iowa domicile
such as (1) evidence that they have not acquired a domicile in another
state, (2) they have maintained a con-
tinuous 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 in 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 con-
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 pre-

All students not classified as resident
students shall be classified as non-resi-
dents for admission, fee and tuition pur-
poses. A student who willfully gives in-
correct 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 provided 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 servicemen) 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 retroactive 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 shall be final.

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 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.

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. If the form is not received at the Health Service prior to registration of the student, he may receive a physical examination from a University physician. Professional fees are charged for this service.

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.
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 program is conducted individually by the College of Agriculture, the College of Engineering, the College of Home Economics, the College of Sciences and Humanities and the College of Veterinary Medicine. Procedures vary somewhat among colleges.

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 July 15. 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.

Attendance at the summer orientation program is not required, but it is strongly advised. A large portion of the incoming students and their parents usually do attend.
FALL ORIENTATION

All new students are required to attend orientation days which precede the opening of the fall quarter. This period includes tests for those who have not attended the summer orientation program, plus registration and the many activities necessary to insure that each new student is properly enrolled and ready to begin his career at Iowa State.

REGISTRATION

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

The instructor in each class receives from the Office of Student Records a class list showing all students properly registered for his class. This list serves as his authority to admit the students to class. Additional students should be admitted only upon presentation of an official add slip. Students are permitted to audit 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.
Fees and Expenses

All fees and expenses listed in this catalog were effective as of September 1, 1966. 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>$345</td>
<td>$345</td>
</tr>
<tr>
<td>Tuition</td>
<td></td>
<td>$585</td>
</tr>
<tr>
<td>Board and room</td>
<td>$735</td>
<td>$735</td>
</tr>
<tr>
<td>Books, supplies and equipment (estimated)</td>
<td>$100</td>
<td>$100</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>$1,180</strong></td>
<td><strong>$1,765</strong></td>
</tr>
</tbody>
</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>12 weeks</td>
<td>$115</td>
<td>$125</td>
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<tr>
<td>10 weeks</td>
<td>$98</td>
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</tr>
<tr>
<td>8 weeks</td>
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<td>$83</td>
</tr>
<tr>
<td>6 weeks</td>
<td>$58</td>
<td>$64</td>
</tr>
<tr>
<td>3 weeks</td>
<td>$42</td>
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<td>2 weeks</td>
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<tr>
<td>1 week</td>
<td>$25</td>
<td>$26</td>
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Light Classification (assessed on a minimum of three hours)

<table>
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<tr>
<th></th>
<th>Iowa Resident</th>
<th>Non-resident</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 hours</td>
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<td>$52</td>
</tr>
<tr>
<td>4 hours</td>
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<td>$66</td>
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<tr>
<td>5 hours</td>
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<td>$108</td>
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<tr>
<td>8 hours</td>
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</table>

Audit—Same as light classification
Off-campus—Same as light classification
In absentia—Same as light classification
Interim Fee

<table>
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<tr>
<th></th>
<th>Iowa Resident</th>
<th>Non-resident</th>
</tr>
</thead>
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<tr>
<td>1 hour</td>
<td>$17</td>
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</tr>
<tr>
<td>2 hours</td>
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<td>$58</td>
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### Fees and Expenses

<table>
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<th>Resident Undergraduate</th>
<th>Resident Graduate</th>
<th>Non-resident Undergraduate</th>
<th>Non-resident Graduate</th>
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</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>
<td>$20</td>
<td>$20</td>
<td>$20</td>
<td>$20</td>
</tr>
<tr>
<td>Special Women's Education</td>
<td>$10</td>
<td>$10</td>
<td>$10</td>
<td>$10</td>
</tr>
<tr>
<td>Change of Classification</td>
<td>$1</td>
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</tr>
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#### Private Music Instruction

<table>
<thead>
<tr>
<th>Service</th>
<th>University students, per quarter</th>
<th>Non-University students, per quarter</th>
</tr>
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<tr>
<td>10 lessons per quarter 1 credit ($25-$30)</td>
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<tr>
<td>20 lessons per quarter 2 credits</td>
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<td>$55</td>
</tr>
<tr>
<td>Practice Room (1 hour per day)</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Electric Organ practice</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Pipe Organ practice</td>
<td>15</td>
<td>15</td>
</tr>
</tbody>
</table>
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 $52. For either term of the summer quarter, the fee is $26.

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 the 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.
Financial Aid

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.

Opportunities for on-campus employment are described in the Student Services section of this catalog. 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 the 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 for needs analysis.

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

STUDENT LOAN FUNDS

Long term loans to be paid after graduation from the University are available either through 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 phased out in favor of the new Guaranteed Loan.

Loans must be used for educational purposes, such as room, board, tuition and 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.

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.

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. The better his high school grades, the better his chances of receiving financial help.

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.

HIGH SCHOLARSHIP RECOGNITION AWARDS

High school graduates in the upper one 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 with College Scholarship Service 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 Loans and Scholarship Office, 9 Beardshear Hall, Iowa State University. Parents Confidential Statement blanks are available at most high schools.
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. Unless otherwise stated, apply to Scholarship Committee, 9 Beardshear Hall.

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

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

General University Scholarships for freshmen and undergraduates. Apply to local counselor or General Scholarship Committee, 9 Beardshear Hall.

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.

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. No application necessary.

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 Technical Journalism Department.

James W. Bell Company, Inc. Scholarship for a Science or Engineering freshman. No application necessary.
James W. Bell "Christmas" Scholarship for a Science or Engineering freshman. No application necessary.

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

W. E. Holmes Scholarship for a freshman enrolling as a journalism major. Apply to Technical Journalism Department.

Journalism Tuition Scholarships for freshmen majoring in journalism. Apply to Technical Journalism Department.

Minneapolis Tribune Scholarship for a senior journalism student.

Ruth Watkins Newton Scholarship for a freshman enrolling as a journalism major. Apply to Technical 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 15. Applications for sophomore, junior and senior scholarships are due either October 15, December 15 or April 15 each year. Students should contact their advisor or the Awards and Scholarship Committee, 121 Curtiss Hall, for further information about these scholarships.

Agricultural Marketing Management Scholarships for agricultural business undergraduates in the marketing management option. Sponsored by the Farmers Elevator Service Company, the Farmers Grain Dealers Association of Iowa, and the Western 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.

Chicago Mercantile Exchange Scholarship for an Iowa freshman.

Chicago and North Western Railway 4-H Scholarships for male agricultural economics or forestry juniors, seniors or graduate students. 4-H background and essay necessary. Apply to state 4-H office by September 15.

Chicago Farmers' Club Scholarship for a senior.

Consumers Cooperative Association Scholarships for juniors and seniors who are male residents of Iowa and whose parents belong to an agricultural cooperative.

Cooperage Industries of America, Inc. Scholarship for a forestry freshman.

Cooperative Education Scholarships for a freshman 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 Miniwanca 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 Miniwanca 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 horticulture freshman. Sponsored by the Iowa Horticulture Society. No application necessary.

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

Electric Cooperative Pioneer Scholarship for a freshman in agricultural journalism.

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

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

Federal Land Bank of Omaha and Federal Land Bank Associations in Iowa Scholarships for male freshmen from an Iowa farm.

Federated Garden Clubs of Iowa, Inc. Scholarships for horticulture and landscape architecture undergraduates. 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 an agronomy sophomore. 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 animal science seniors. 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.

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

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

Iowa Hoo-Hoo Club Forestry Scholarship for a forestry sophomore. No application necessary.

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

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

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

Iverson Honorary Dairy Industry Scholarships for dairy industry 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 fisheries and wildlife biology students. 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.

Eli Lilly Advanced Curriculum Scholarships for sophomores who have earned a 3.0 cumulative average and plan to follow the advanced curriculum.

Midwest Agricultural Chemicals Association Marketing Scholarship for a junior or senior student whose home is in Iowa, Illinois, Kansas, Missouri, or Nebraska.

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 poultry science freshmen. 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 agricultural business, animal, dairy or poultry science, agricultural journalism, agronomy, farm operation or agricultural education senior. No application necessary.

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.

Sears-Roebuck Foundation Scholarships for freshmen who live on Iowa farms.

Sears-Roebuck Foundation Sophomore Scholarship for the sophomore who earned the highest grade average among the previous year's freshman recipients. No application necessary.

Smith-Douglass Company, Inc. Scholarship for a male freshman in agronomy.

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

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.

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

J. R. Watkins Company 4-H Scholarship for an Iowa freshman with a strong 4-H background.

H. K. Wilson Advanced Curriculum Scholarship for 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 January 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.

Aloca Engineering Achievement Scholarship for an Engineering senior.

Aloca Engineering Scholarships for undergraduates in Engineering.
American Institute of Industrial Engineers Scholarship for an industrial engineering senior.

Archer-Daniels-Midland Company Scholarship for a chemical engineering senior.

Babcock and Wilcox Scholarships for undergraduates in Engineering and the Technical Institute.

Black and Veatch Scholarships for Engineering freshmen.

E. W. Bliss Scholarship for an Engineering freshman. Apply to E. W. Bliss Company, Canton, Ohio.

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

Bourns' Incorporated Scholarship for electrical, mechanical or industrial engineering junior or senior.

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

Wallace A. Cassell Memorial Scholarship for electrical engineering junior or senior.

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

Cedar Rapids Engineers' Club Scholarships for Engineering freshmen. Apply to Cedar Rapids Engineers' Club, Cedar Rapids.

Continental Oil Company Scholarship for a chemical engineering undergraduate.

Claud Coykendall Memorial Scholarship for a civil engineering senior.

Leo A. Daly Scholarship for an architecture undergraduate.

Dr. J. B. Davidson Scholarship for an agricultural engineering undergraduate and/or graduate student.

Durant, Deiniger, Dommer, Kramer and Gordon Scholarship for architecture senior.

Douglas Aircraft Company Scholarship for an aerospace or electrical engineering senior.

Engineers' Club of Des Moines Scholarship for an Engineering freshman who is a graduate of a Des Moines high school. Apply to Engineers' Club of Des Moines.

Engineers' Club of Sioux City Scholarship for an Engineering freshman who is a graduate of a Sioux City high school. Apply to Engineers' Club of Sioux City.

Fisher Foundation Scholarships for chemical, electrical, mechanical or nuclear engineering undergraduates.

Almon H. Fuller Scholarship for a civil engineering senior.

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

Goodyear Scholarship for a chemical engineering senior.

Frank W. Griffith Educational Award for an architecture student.

Walter Handy Memorial Scholarship for a civil engineering junior.

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

Iowa Limestone Producers Association Award for a civil engineering senior.

Karl Kefler Scholarship for an architecture undergraduate.

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

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

Koppers Company, Inc. Award for outstanding architectural design.

Link-Belt Speeder Corporation Scholarship for a mechanical engineering sophomore.
Fred F. Loy Memorial Award for a civil engineering junior or senior.
Master Builders of Iowa Scholarship for an architecture or civil engineering junior or senior.

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

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

Minnesota Mining and Manufacturing Company Scholarships for Engineering undergraduates.

Missouri Valley Machinery Company Scholarships for Engineering freshmen.

Missouri Valley Steel Company Scholarship for a civil, mechanical or architectural engineering freshman.

Nebraska Lath & Plaster Scholarships for architecture seniors.

Carl E. Nelson Scholarship for an undergraduate in Engineering.

Herman W. Nelson Memorial Scholarship for a mechanical, electrical or industrial engineering senior.

Northwest Chapter Iowa Engineering Society Scholarship for an Engineering freshman. Apply to Scholarship Committee, Northwest Chapter Iowa Engineering Society.

Paxton-Vierling Steel Company Scholarship for a civil engineering freshman.

Pennsylvania Glass Sand Corporation Scholarship for a ceramic engineering senior.

No application necessary.

Rath Packing Company Scholarship for a mechanical engineering undergraduate.

Russell Thompson Memorial Scholarship for an undergraduate sophomore.

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

Texaco Oil Company Scholarship for a chemical engineering junior or senior.

Union Carbide Engineering Scholarship for a mechanical, chemical or metallurgical engineering freshman.

Universal Oil Products Company Scholarships for a chemical engineering senior and two juniors.

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

Western Electric Fund Scholarship for an Engineering undergraduate.

Leonard Wolf Memorial Scholarship for an architecture junior or senior.

**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.

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

Bishop-Stoddard Cafeteria Scholarship for Men for a student majoring in institution management. Inquire at Institution Management Department, 11E MacKay Hall.

Borden Home Economics Scholarship for a Home Economics senior with the highest grade point average among eligible senior students (two or more courses in food and nutrition). No application.

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, 11 E MacKay Hall.

Danforth Award for Home Economics College Senior. Apply junior year.

Danforth Leadership Training Scholarship for a Home Economics freshman. No application necessary.

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

Julie Diekmann Applied Art Senior Award for a senior woman in applied art. No application necessary.

Farm Journal Scholarship for a high school student planning to major in home economics journalism.

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 Association Scholarships for a sophomore, junior, or senior student in Home Economics.

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

Millie Kalsam 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.

Charles Pfizer Extension Scholarship for a junior interested in extension work with 4-H record and one or more extension courses. Apply to State 4-H Club Office, 303 Curtiss Hall.

Phi Upsilon Omicron Scholarship for a sophomore or junior student in Home Economics.

Sears-Roebuck 4-H Poultry Scholarship for a freshman in Home Economics who has taken part in a 4-H laying flock project.

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 Home Economics.
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.

Veishea 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 Scholarships for sophomores and juniors.

J. R. Watkins 4-H Scholarship for a Home Economics freshman with a record of major accomplishments in 4-H Club work.

Lane-Wells—George Catt Scholarship for seniors with good scholastic records for students who have earned a major part of their expenses.

**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. Apply to J. D. Woods, Drake University, Des Moines.

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 Technical 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 student who shows proficiency in large animal medicine.

Upjohn Award for a student 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.

Burton C. Thompson Award for a first year veterinary student.

Ival Arthur Merchant Award for a second year student in veterinary medicine.

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.
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 has completed at least 243 college credits and if heads of both curricula recommend him for each degree.

ENGLISH REQUIREMENT

The University grants degrees only to those persons who have demonstrated, through an examination, that they can express themselves clearly and correctly in the English language. All seniors pass this examination before graduation. The examination consists of a 500-word written exposition which is judged on spelling, punctuation, grammar, clarity of expression and the organization and development of the subject.

All students take instruction in English composition throughout the freshman year, and nearly all take one course in speech later. They may continue to receive help and advice in English through the Writing Clinic and the Speech Clinic, both of which are supervised by members of the Department of English and Speech.

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.
GRADING SYSTEM

The mark P may be used for undergraduate "required" courses and may also be given to graduate students to indicate satisfactory progress in research, special topics or "required" courses.

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

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<th>Grade</th>
<th>Points</th>
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<tr>
<td>A</td>
<td>4 points</td>
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<tr>
<td>B</td>
<td>3 points</td>
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<tr>
<td>C</td>
<td>2 points</td>
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<tr>
<td>D</td>
<td>1 point</td>
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<tr>
<td>F</td>
<td>0 points</td>
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Grade reports are prepared each quarter and are supplied to students upon their request. 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. Excuse from any class period is a matter between the student and his instructor.

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 of 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.

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.
Student Housing

J. C. Schilletter, Ph.D., Director of Residence
Charles F. Frederiksen, M.S., Associate Director of Residence
Edna V. Eland, B.A., Assistant Director of Residence
Robert J. Benson, M.S., Assistant to the Director of Residence

The University maintains residence halls for approximately 2,550 single women and 4,500 single men. University apartments are available for approximately 1,150 married students. Chapter houses are maintained near the campus by 34 fraternities and 10 sororities and house about 2,300 students. Other members of the student body live in private rooms or apartments in Ames or nearby communities. A sizable group commutes from Des Moines and from other cities and towns in central Iowa.

Inquiry concerning rooms in University facilities should be addressed to the Director of Residence, Friley Hall. Applications are accepted beginning September 1 for the following fall quarter.

A $25 deposit is required at the time a reservation is completed for a room in a residence hall or an apartment operated by the University. The deposit is returned when the student releases the room or apartment at the end of a quarter or if he withdraws from the University, provided he notifies the University in terms of his contract and provided he has no outstanding bills to the University.

The Residence Halls

Residence halls at Iowa State have complete facilities for comfortable living. All have spacious lounges. Most have recreation rooms. A house mother resides in each residence hall.

Friley Hall contains a snack bar, radio station, exercise room and hobby rooms. In its two large dining rooms the residents of Friley, Helser and Westgate Halls are served cafeteria style.

The Knapp-Storms Commons also provides cafeteria style food service for 1,200 men. Birch, Linden, Elm-Oak and Welch Halls have dining rooms which serve all of the
women's residence halls. Meals are served cafeteria style.

Most rooms in residence halls are planned for double occupancy.

Charges for residence halls (except Buchanan Hall) include both room and board. All charges are subject to change without notice, but the rate for the academic year established January 1, 1967, is $735. Room rates in Buchanan Hall for the academic year are $315 for double occupancy and $420 for single occupancy. Rooms are rented on the basis of the entire academic year. Students should not request rooms in the residence halls if they do not plan to occupy them for a full academic year. Most fraternities ask pledges to live at the chapter house during a portion of the year. Students who plan to pledge fraternities should not seek rooms in the residence halls.

All undergraduate women (except those 21 or over) are required to live in residence halls or sororities unless special exception is made by the Director of Residence.

Rooms in residence halls are furnished with single beds and mattresses, chests of drawers, study tables and straight chairs. Students furnish their own mattress pads, pillows, bed linen, towels, throw rugs, study lamps, and curtains.

**Married Student Housing**

Rates for married student apartments operated by the University, as of January 1, 1967, were $32 per month in Pammel Court, $65 per month in Hawthorn Court, and $70 or $80 per month in University Village. Apartments are unfurnished. The University provides water, but tenants pay other utilities. Changes in rental rates may be made at any time.

Applications are accepted one year in advance of registration.

Approximately half of the married students at Iowa State live in University apartments. The remainder find accommodations in private houses or apartments and in trailer courts in and near Ames.
Off-Campus Housing for Single Students

Single men may obtain housing in private quarters off campus. Arrangements are made directly with the owners, and accommodations vary in price and desirability. The contract is usually for one quarter.

It is best if the new student comes to Ames well in advance of the quarter in which he enrolls, and personally makes arrangements for an off-campus room.

Off-campus room rates January 1, 1967, generally were $8 per week for each occupant where a room accommodates two and $10 per week where the room is occupied by one student. Students usually furnish their own linens.

Meals may be obtained in restaurants near the campus or in the Memorial Union on an individual meal basis for about $20 per week.

A list of approved rooms for students may be obtained from the Director of Residence. The Department of Residence has prepared a standard set of requirements for householders furnishing rooms to students and reserves the right to restrict student housing to those rooms which meet University requirements.
The University Library contains nearly 600,000 volumes used in the support of the University's teaching, research, and extension programs. The collections are strong in all fields stressed at the University. They are strong in periodicals and other serials in the basic and applied fields of the physical and biological sciences including exhaustive coverage in such applied fields as veterinary medicine, engineering, and home economics. Many of the serials holdings of the Library are complete to date. The Library is strengthening its collections in the social sciences as well as the liberal arts and humanities.

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.

Both formal and informal instruction in the use of books and libraries are offered to undergraduate and graduate students. Special services such as the procurement of interlibrary loans and microfilm copies are available. Xerox copies of material are also made.

In order to accommodate more satisfactorily the increasing numbers of students, plans for a second addition to the Library have been made and early planning for a third addition has begun.

THE OFFICE OF THE DEAN OF STUDENTS

Millard R. Kratochvil, A.M., Dean of Students
Eugene E. Robinson, Ph.D., Associate Dean of Students
Paul R. McQuilkin, M.B.A., Assistant Dean of Students
Vida S. Benson, B.S., Social Director
Eugene L. Clubine, M.S., Coordinator, Foreign Student and Visitor Services
Maurice S. Kramer, M.S., Foreign Student Adviser
Gerald B. Sholes, B.S., Assistant Foreign Student Adviser

Functioning in the broad area of student life not specifically related to academic courses of study, 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. Sometimes it works with individuals and at other times with student organizations and activities. 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; handle disciplinary matters; and coordinate the religious activities of campus groups and the various churches in Ames.

STUDENT COUNSELING SERVICE

Martin F. Fritz, Ph.D., Director

Functioning as a part of the Office of the Dean of Students, the Student Counseling Service provides, without charge, testing and consulting service for regularly enrolled students. This includes educational, vocational and personal counseling. Students may come on their own initiative or they may be referred by academic advisers or other staff members. Emotional and personal problems are given consideration in cooperation with the Student Health Service. A limited amount of pre-college testing and counseling is also available to high school students, seniors or graduates at a nominal cost to the individual.
STUDENT EMPLOYMENT SERVICE

Jess N. Cole, B.S., Personnel Officer

To assist students in securing part-time employment, the University maintains a student employment service as part of the Personnel Office, 1 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. Inquires 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.

New students are advised against employment their first quarter at Iowa State. After initial adjustment to University routine, they can better determine how many hours they can spare for outside work.

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

STUDENT HEALTH SERVICE

Gail McClure Proffitt, M.D., Director

John G. Grant, M.D.
C. V. Hamilton, M.D.
Richard Konzen, M.S.,
R. L. McCormack, M.D.
Kenneth C. Percy, M.D.
F. N. Roemhild, M.D.
V. T. Ryding, M.D.
George J. Uhl, M.D.

The University maintains a well-equipped hospital and dispensary for the care of students. Routine medical advice and treatment are given through the dispensary without charge. Medicines and services such as x-ray, are provided at cost. Hospital service is at a nominal rate 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 9 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.
Student Life

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.

As part of the Religion in Life emphasis, a series of lectures is presented throughout the school year on topics which are aimed at challenging students to a deeper exploration of their religious beliefs. These lectures are given by nationally recognized speakers and are presented as all-university convocations. In addition, these speakers are available for informal residence discussions and personal consultation. These and other religious activities are planned and coordinated by the Student Religious Council.

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.

Church-going is a continuing tradition at Iowa State, and 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, is 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

The Iowa State Debaters participate in many kinds of speech experience. In addition to intercollegiate debate, they sponsor extemporaneous speaking, radio and television discussions and public speeches before business and professional organizations. Each year the Debaters attend approximately 15 intercollegiate debate and speech tournaments. They sponsor an intercollegiate invitational tournament held on the Iowa State campus, and they also conduct a yearly speech tournament for high schools of the Midwest. The University is a member of the Missouri Valley Forensic League, and has a chapter of Delta Sigma Rho-Tau Kappa Alpha, national forensics honorary society.

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 in both vocal and instrumental music as well as courses in music appreciation and history, harmony, 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.

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

- Sociology
- Freshmen (women)
- Agriculture and Veterinary Medicine (men)
- Agriculture and Veterinary Medicine
- Home Economics (women)
- Freshmen (men)
- All-university
- Veterinary Medicine
- Scientific research
- Engineering (men)

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

In addition, activities honoraries focus their requirements on the basis of interest, participation or special attainment in all-university activities. Cardinal Key and Mortar Board are the highest activity 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
- The Iowa Homemaker: published by students of the College of Home Economics
- The Iowa State University Veterinarian: official publication of the student chapter of the American Veterinary Medical Association
- The Iowa Engineer: published by students of the College of Engineering
FRATERNITIES AND SORORITIES

All social fraternities and sororities are under 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 34 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 $87 to $110 per month, with an average cost of $93. 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 10 recognized national social sororities provide living accommodations for approximately 500 women. The monthly house bill for each member of these chapters ranges from $85 to $103, 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 ASSOCIATION

Students living in men's residence halls are members of the Men's Residence Association. The Association includes 74 "houses" which are set up as units within the men's residence halls. Each unit of 40 to 80 men elects its own officers, has its own program of social activities and competes in intramural athletics. The Men's Residence Association includes all such groups and has its own officers, a social program, and a radio station which serves all the residence halls.

WOMEN'S RESIDENCE ASSOCIATION

Women living in residence halls are members of the Women's Residence Association. The women organize their groups according to houses or halls for social activity, intramural sports and similar activities.

THE WARD SYSTEM

The Ward System is an organization of men and women living outside residence halls, fraternities and sororities. As a local branch of the National Independent Student Association, 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, Ward System provides the opportunity for its members to develop their own leadership capabilities.

The residential area of Ames is divided into four districts, or wards, for men, and one ward which serves all off-campus women. Each ward elects its own officers and works with the Executive Council, which serves as a central guidance body.

Membership in the Ward System is $4 for the academic year.

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.
Alumni

ALUMNI ASSOCIATION

Wallace E. Barron, B.S., Director of Alumni Affairs

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 nearly 64,000 living alumni of record. The office of the Association is off the main lobby of Memorial Union. Active local clubs of the general association are found in most 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

John E. Granson, B.S., Director

The Alumni Achievement Fund is an annual giving program sponsored by the Alumni Association for alumni, former students and friends of the University and many industries interested in Iowa State. Its purpose is to provide alumni and friends with an opportunity to assist in extending the usefulness and prestige of the University and to help the University meet needs which would not be satisfied ordinarily through regular appropriations. The Fund is administered by a board of eight trustees who appoint the personnel necessary to conduct its business. Officers for the Alumni Achievement Fund are in Room 242, Memorial Union.

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 59 governors, mostly alumni, represents all areas of the nation.
College of Agriculture

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 provides some notion of the opportunities:

- Farming and related enterprises such as nursery production, raising fruits and vegetables, managing greenhouse crops, and growing timber or woodlands.
- Research in agriculture, either 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, marketing food products, and providing necessary supplies or service to farmers.
- Special services, including landscape planning, turfgrass management, establishment of parks and playgrounds.
- 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 on Page 139.
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<th>Subject Group</th>
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<tbody>
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<td>I English and Speech</td>
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</tr>
<tr>
<td>II Mathematics or Mathematics and Statistics</td>
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<tr>
<td>III Physical Sciences</td>
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<tr>
<td>Biochemistry, Biophysics, Chemistry, Earth Science excluding courses in Geography, and Physics</td>
<td>16</td>
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<tr>
<td>Up to 5 credits in Mathematics above Mathematics 101 may be substituted for Physical Sciences</td>
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<tr>
<td>IV Biological Sciences</td>
<td>10</td>
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<tr>
<td>Bacteriology, Biochemistry, Biophysics, Botany, Genetics, Zoology</td>
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</tr>
<tr>
<td>V Social Sciences and Humanities</td>
<td>12</td>
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<tr>
<td>Economics, Government, Psychology, Sociology</td>
<td>12</td>
</tr>
<tr>
<td>Art, History, Literature, Music, Philosophy</td>
<td>6</td>
</tr>
</tbody>
</table>

Most undergraduate study in the College of Agriculture covers a period of four years and leads to the degree Bachelor of Science, but several curricula also have a two-year program which leads to a Certificate in Technical Agriculture. 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 Bachelor of Science Degree

<table>
<thead>
<tr>
<th>Curriculum or Major</th>
<th>Department</th>
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<td>Agronomy</td>
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<td>Animal Science</td>
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<td>Dairy Science</td>
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<td>Entomology</td>
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<td>Farm Operation</td>
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<td>Fisheries and Wildlife Biology</td>
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<td>Food Technology</td>
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<td>Forestry</td>
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<td>Industry</td>
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<td>Landscape Architecture</td>
<td>Landscape Architecture</td>
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<tr>
<td>Plant Pathology</td>
<td>Botany and Plant Pathology</td>
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<td>Poultry Science</td>
<td>Poultry Science</td>
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<td>Production</td>
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<td>Science</td>
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<td>Industry</td>
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<td>Resource Development for Outdoor Recreation</td>
<td>College of Agriculture</td>
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<tr>
<td>Soil Science</td>
<td>Agronomy</td>
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<tr>
<td>Urban Planning</td>
<td>Landscape Architecture</td>
</tr>
</tbody>
</table>

## Leading to the Degree Associate in Agriculture

A two-year Technical Institute Program in Agriculture administered through the Office of the Associate Dean. (See index)

## Leading to Two-Year Certificate in Agriculture

A two-year Collegiate Program is available in the departments of Agricultural Business, Agronomy, Animal Science, Dairy Science, Farm Operation, Horticulture, Industrial Education and Poultry Science. (See index)

## Curriculum in Agricultural Business

Administered by the Department of Economics.

Leading to the degree Bachelor of Science. Total credits required, 200 plus six credits of physical education.

A student preparing for the study of law may complete three years of specialized study under the Agricultural Business curriculum followed by one year in a recognized law college, after which the degree Bachelor of Science in Agriculture will be awarded by Iowa State University.

See also Technical Agriculture for two-year program.

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 completing 140 credits 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:**

<table>
<thead>
<tr>
<th>FALL QUARTER</th>
<th>WINTER QUARTER</th>
<th>SPRING QUARTER</th>
</tr>
</thead>
<tbody>
<tr>
<td>Credits</td>
<td>Credits</td>
<td>Credits</td>
</tr>
<tr>
<td>Freshman Year</td>
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</tr>
<tr>
<td><strong>Ag Economics</strong></td>
<td><strong>Prin of Crop Prod</strong></td>
<td><strong>Elem of Livstk Prod</strong></td>
</tr>
<tr>
<td>Econ 121</td>
<td>Agron 114A</td>
<td>4</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td>4</td>
</tr>
<tr>
<td><strong>Prin of Composition</strong></td>
<td><strong>Prin of Composition</strong></td>
<td><strong>Prin of Composition</strong></td>
</tr>
<tr>
<td>Engl 101</td>
<td>Engl 102</td>
<td>Engl 103</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td><strong>Gen Chemistry</strong></td>
<td><strong>Gen Chemistry</strong></td>
<td><strong>Intro To Sociology</strong></td>
</tr>
<tr>
<td>Chem 101*</td>
<td>Chem 102</td>
<td>Soc 134</td>
</tr>
<tr>
<td>4</td>
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<td>4</td>
</tr>
<tr>
<td><strong>Algebra &amp; Trig I</strong></td>
<td><strong>Gen Botany or Math 101</strong></td>
<td><strong>Rural Sociology or Soc 200</strong></td>
</tr>
<tr>
<td>Math 101*</td>
<td>Bot 101</td>
<td>Soc 200</td>
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<tr>
<td>5</td>
<td>or</td>
<td></td>
</tr>
<tr>
<td><strong>Orientation in Ag Bus</strong></td>
<td><strong>Prin of Zoology</strong></td>
<td><strong>Physical Science</strong></td>
</tr>
<tr>
<td>Econ 110</td>
<td>Zoal 101</td>
<td>or</td>
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<td>R</td>
<td>4-5</td>
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</tr>
<tr>
<td><strong>Gen Psychology I</strong></td>
<td><strong>Gen Psychology I</strong></td>
<td><strong>Math elective</strong></td>
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<tr>
<td>Psych 101</td>
<td>Psych 101</td>
<td><strong>or</strong></td>
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### FALL QUARTER

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<tr>
<td>Prin. of Economics</td>
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<tr>
<td>Econ 241</td>
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<tr>
<td>American Government</td>
<td>3</td>
</tr>
<tr>
<td>Govt. 215</td>
<td></td>
</tr>
<tr>
<td>Intro. Bacteriology I</td>
<td>3</td>
</tr>
<tr>
<td>Bact 200</td>
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<tr>
<td>Library Instruction</td>
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<td>Lib 116A</td>
<td></td>
</tr>
<tr>
<td>Money and Banking</td>
<td>3</td>
</tr>
<tr>
<td>Econ 304</td>
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<tr>
<td>Farm Mgt &amp; Organ</td>
<td>4</td>
</tr>
<tr>
<td>Econ 330</td>
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<tr>
<td>Intro. Genetics</td>
<td>3</td>
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<tr>
<td>Gen. 301</td>
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<tr>
<td>Accounting I</td>
<td>4</td>
</tr>
<tr>
<td>I Ad 384</td>
<td></td>
</tr>
<tr>
<td>Intro. Ag Policy</td>
<td>3</td>
</tr>
<tr>
<td>Econ 447</td>
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### WINTER QUARTER

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<thead>
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<tr>
<td>Econ 242</td>
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</tr>
<tr>
<td>Prin. of Statistics</td>
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<td>Stat 201</td>
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<tr>
<td>Psych. of Sales</td>
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</tr>
<tr>
<td>Psych 250</td>
<td></td>
</tr>
<tr>
<td>Fund. of Speech</td>
<td>3</td>
</tr>
<tr>
<td>Sp 211</td>
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<tr>
<td>Price &amp; Res. Alloc.</td>
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<tr>
<td>Econ 307</td>
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<tr>
<td>Agricultural Law</td>
<td>3</td>
</tr>
<tr>
<td>Econ 451 or</td>
<td></td>
</tr>
<tr>
<td>Business Law I</td>
<td>3</td>
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<tr>
<td>I Ad 365</td>
<td></td>
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<tr>
<td>Accounting II</td>
<td>3</td>
</tr>
<tr>
<td>I Ad 385</td>
<td></td>
</tr>
<tr>
<td>Animal Nutrition</td>
<td>4</td>
</tr>
<tr>
<td>An. Aci 318</td>
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<tr>
<td>Intro. Ag Policy</td>
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<tr>
<td>Econ 447</td>
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<tr>
<td>Correspondence</td>
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<tr>
<td>Engl 404</td>
<td></td>
</tr>
<tr>
<td>or Writing of Sci. Papers</td>
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<tr>
<td>Engl 414</td>
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### SPRING QUARTER

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<thead>
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<tr>
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<tr>
<td>Econ. 292</td>
<td></td>
</tr>
<tr>
<td>Fund of Soil Science</td>
<td>4</td>
</tr>
<tr>
<td>Agron 154A</td>
<td></td>
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<tr>
<td>Elem. Organic Chem.</td>
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<tr>
<td>Chem. 231A</td>
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<tr>
<td>Price &amp; Res. Alloc.</td>
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<tr>
<td>Econ. 308</td>
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<tr>
<td>Ag Marketing</td>
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<tr>
<td>Econ 335</td>
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</tr>
<tr>
<td>Applied Nutrition</td>
<td>4</td>
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<tr>
<td>An. Sci 319</td>
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<td>Labor Economics</td>
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<td>Econ. 305</td>
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<tr>
<td>Humanities elective**</td>
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<tr>
<td>Public Finance</td>
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<tr>
<td>Econ. 405 or</td>
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<tr>
<td>Natl. Income &amp; Employ.</td>
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</tr>
<tr>
<td>Econ. 409</td>
<td></td>
</tr>
</tbody>
</table>

*Students are placed in Chemistry 101, 101A or 102A and Mathematics 101B, 101, 102 or 110 consistent with preparation.

**See group requirements for the College of Agriculture for a description of physical science and humanities.

Each student is required to include in his freshman and sophomore years six credits of physical education. Students electing to take ROTC may apply these credits toward elective requirements.
Curriculum in Agricultural Education

With Options in Teaching and Business

Leading to the degree Bachelor of Science. Total credits required, 200, plus six 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 as educational personnel in related agricultural businesses and industries.

### Teaching Option

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<tr>
<th>FALL QUARTER</th>
<th>WINTER QUARTER</th>
<th>SPRING QUARTER</th>
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</thead>
<tbody>
<tr>
<td><strong>Credits</strong></td>
<td><strong>Credits</strong></td>
<td><strong>Credits</strong></td>
</tr>
<tr>
<td><strong>Freshman Year</strong></td>
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<tr>
<td>Prin of Composition</td>
<td>Engl 101</td>
<td>Prin of Composition</td>
</tr>
<tr>
<td>Prin of Horticulture</td>
<td>Hort 114A</td>
<td>Metal Construction</td>
</tr>
<tr>
<td>Algebra and Trig</td>
<td>Math 101B</td>
<td>Elements of Livestock Production</td>
</tr>
<tr>
<td>Drafting for Agricultural Students</td>
<td>1 Ed 154</td>
<td>General Botany</td>
</tr>
<tr>
<td>Prin of Crop Production</td>
<td>Agron 114A</td>
<td>Algebra and Trig</td>
</tr>
</tbody>
</table>

In addition to the courses listed, each student will be required to include in his freshman and sophomore years Ed 110, Ag 104 and six credits of physical education. Students electing to take ROTC may apply ROTC credit toward elective requirements.

### Sophomore Year

<table>
<thead>
<tr>
<th><strong>Credits</strong></th>
<th><strong>Credits</strong></th>
<th><strong>Credits</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>General Chemistry</td>
<td>Chem 101</td>
<td>General Chemistry</td>
</tr>
<tr>
<td>Weed Identification and Control</td>
<td>Bot 216</td>
<td>Fundamentals of Soil Science</td>
</tr>
<tr>
<td>Publicity and Public Relations</td>
<td>T Jl 225</td>
<td>Principles of Zoology</td>
</tr>
<tr>
<td>Library Instruction</td>
<td>Lib 116</td>
<td></td>
</tr>
<tr>
<td><strong>Technical Agriculture</strong></td>
<td><strong>Science</strong></td>
<td><strong>Professional</strong></td>
</tr>
<tr>
<td>A E 334</td>
<td>Electives in Phys.</td>
<td>Psych 333</td>
</tr>
<tr>
<td>A E 415</td>
<td>Chem or Earth Sci</td>
<td>3</td>
</tr>
<tr>
<td>Electives in A E</td>
<td>Gen 301</td>
<td>3</td>
</tr>
<tr>
<td>Agron 354</td>
<td>Speech and Humanities</td>
<td>3</td>
</tr>
<tr>
<td>Electives in Agron or Hort</td>
<td>Speech 211</td>
<td>3</td>
</tr>
<tr>
<td>An Sci 318</td>
<td>Electives in Art, Hist.</td>
<td>3</td>
</tr>
<tr>
<td>An Sci 319</td>
<td>Lit., Music and Phil</td>
<td>3</td>
</tr>
<tr>
<td>Electives in An Sci</td>
<td>7</td>
<td>Electives</td>
</tr>
<tr>
<td>Po Sci 365</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Econ 329</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Econ 330</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Electives in Econ, Ag or Rural Soc</td>
<td>8</td>
<td></td>
</tr>
</tbody>
</table>
The junior and senior years will cover a minimum of 106 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, Ag. Ed. 424 and Ag. Ed. 425:

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Marketing Business Operations</td>
<td>4</td>
</tr>
<tr>
<td>Econ 292</td>
<td></td>
</tr>
<tr>
<td>Industrial Marketing I</td>
<td>3</td>
</tr>
<tr>
<td>1 Ad 340</td>
<td></td>
</tr>
<tr>
<td>Business Correspondence</td>
<td>2</td>
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<tr>
<td>Engl 404</td>
<td></td>
</tr>
<tr>
<td>Business Law I</td>
<td>3</td>
</tr>
<tr>
<td>1 Ad 365C</td>
<td></td>
</tr>
<tr>
<td>Accounting I</td>
<td>4</td>
</tr>
<tr>
<td>1 Ad 384</td>
<td></td>
</tr>
<tr>
<td>Psychology of Sales and Advertising</td>
<td>4</td>
</tr>
<tr>
<td>Psych 250</td>
<td></td>
</tr>
<tr>
<td>Business and Professional Speaking</td>
<td>3</td>
</tr>
<tr>
<td>Sp 312</td>
<td></td>
</tr>
<tr>
<td>Persuasion</td>
<td>3</td>
</tr>
<tr>
<td>Sp 334</td>
<td></td>
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<tr>
<td>Advertising</td>
<td>3</td>
</tr>
<tr>
<td>T Jl 325</td>
<td></td>
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</tbody>
</table>

**Curriculum in Agricultural Engineering**

Administered jointly by the College of Agriculture and the College of Engineering.

See *Engineering, Curricula*

**Curriculum in Agricultural Communication**

Administered by the Department of Technical Journalism.

Leading to the degree Bachelor of Science. Total credits required, 200 plus professional requirement and six credits of physical education.

**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: 18 credits required. Must include Engl 101, 102, 103, Sp 211
2. Mathematics, or mathematics and statistics: 10 credits. Math 101
7. Foreign Language: 8 credits.
8. Journalism: 32 credits. 101, plus two but no more than four courses from each of Groups A and B, and at least three courses from Group C. Group

9. Area of concentration in agriculture and related subject matter. 15 credits.

• Students are encouraged, though not required, to enroll in Stat. 201 or Stat. 201A.
• Students must enroll in a minimum of six hours in each of the animal and plant science areas.
• Students seeking a subject matter concentration in the animal sciences are encouraged to include Chemistry 231 in the physical science group substitute An. Sc. 318 for An. Sc. 218 in the agricultural group.

General Requirements

1. Other required courses. 13 credits. Six credits in physical education. Lib. 116, 1 credit. Ag. 110 required. T. Jl. 490J, professional work requirement, 6 credits. Involves three months of full-time experience, or equivalent, in professional mass communication work.

2. Electives. 40 credits.

3. Freshman year: During this year the student should complete 9 credits in Written English (Group 1) and at least 5 credits in Mathematics (Group 2), 101 in Group 8 and at least 30 hours in Groups 3, 4, 5 or 6 with more than one group represented.

4. Sophomore year. In the sophomore year, the student is expected to complete at least two of the Group A courses in Journalism.

5. Junior and senior years: Completion of group requirements remaining. Completion of Journalism major and area of concentration. Electives. Students electing to take ROTC may apply such credits to the elective requirement. Fulfillment of the professional work requirement. (T. Jl. 490J).

Curriculum in Agronomy

With majors in General Agronomy, Crop Science, Soil Science and Agricultural Climatology.

Leading to the degree Bachelor of Science. Total credits required, 200, plus six credits of physical education.

See also Technical Agriculture for two-year program.

The Agronomy curriculum provides a broad training in agriculture with supporting work in the natural sciences and the humanities. Students have the opportunity of selecting one of four majors within the Agronomy Department.

A major in General Agronomy prepares students for positions requiring a broad knowledge of all phases of Agronomy and of their relationship to agricultural business. Graduates may be employed as farm operators and managers or may accept positions in agricultural industries, such as the seed and fertilizer industries, or in education and government positions such as agricultural extension and soil conservation.

A major in Crop Science, Soil Science or Agricultural Climatology prepares students for positions that require a greater specialization in certain areas of Agronomy and basic sciences than is required for the General Agronomy major. Such training will qualify graduates as soil or crop scientists and as technical specialists with chemical and other industries as well as government agencies. Completion of one of these majors also prepares students for graduate study, which leads to positions in education and research with colleges, universities, industries and government agencies.

In addition to the departmental major, a student must declare one or two minors. This declaration must be made prior to the completion of 140 hours. Students declaring one minor must include 20 hours of approved credit in the minor. Students declaring two minors must include at least 15 hours of approved credit in each minor. Specific minors may be elected in any field offering a major with the approval of the minor department. General minors may include Business, Science, Fertilizer Technology, Seed Technology, Turfgrass Management, International Service in Agriculture, Soil Conservation and Land Appraisal, and Agricultural Communication.
Core Requirements

<table>
<thead>
<tr>
<th>FALL QUARTER</th>
<th>WINTER QUARTER</th>
<th>SPRING QUARTER</th>
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<tbody>
<tr>
<td>Credits</td>
<td>Credits</td>
<td>Credits</td>
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<tr>
<td>Freshman Year</td>
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</tr>
<tr>
<td>Prin of Crop Prod</td>
<td>Intro to Geology</td>
<td>Fund of Soil Science</td>
</tr>
<tr>
<td>Agron 114A</td>
<td>Agron 100</td>
<td>Agron 154A</td>
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<tr>
<td>4</td>
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<tr>
<td>Prin of Comp</td>
<td>Gen Chemistry</td>
<td>Intro to Plant Science</td>
</tr>
<tr>
<td>Engl 101</td>
<td>Chem 102</td>
<td>Bot 210</td>
</tr>
<tr>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Algebra &amp; Trig 1B</td>
<td>Algebra &amp; Trig 1C</td>
<td>Gen Psych 1</td>
</tr>
<tr>
<td>* Math. 101B</td>
<td>Math 101C</td>
<td>Psych. 101</td>
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<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Gen Chemistry</td>
<td>Prin of Comp</td>
<td>Prin of Comp</td>
</tr>
<tr>
<td>* Chem 101 or 101A</td>
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<td>Engl 103</td>
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<td>3</td>
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</tbody>
</table>

In addition to the courses listed, each student will be required to include the following Agron 110, Ag 104 (must be completed before beginning of senior year) and six credits of physical education.

Students electing to take ROTC may apply ROTC credits toward the elective requirement.

*See Mathematics and Chemistry for descriptions of beginning courses. Course selected should be consistent with preparation.

Core Group Requirements

As a prerequisite to graduation, to provide breadth of educational experience, and to gain competence in Agronomy, each student must complete credits in the areas of learning specified below. The exact number of credits in each area depends on the major selected as well as choice of elective. The courses listed must be taken by all students.

2. Biological Sciences (23-31 hrs.) Bot 210, 310, 407; Gen 301, Bact 304 or 200 and 300, Zool 101
3. Written and Spoken English (16 hrs.) Engl. 101, 102, 103, Lab 116, Sp 211; T Jl. 225
4. Mathematics and Statistics (8-24 hrs.) Math 101 or 101B and 101C, Stat 201A or 201. According to the student’s preparation, Math 102 or 110 may be elected
5. Physical Sciences (19-49 hrs.) Chem 101, 102, Geol 100, Phys 111
6. Social Sciences and Humanities (21 hrs.) Econ. 241, 242, Govt. 215; Psych 101; Soc 134, 6 hrs. Humanities Elective One year of foreign language is recommended, but not required
7. Electives. 32-35 hrs. plus 6 credits P. E.

Major Requirements

In addition to the required courses listed above, a student will be required to take the following courses in his selected major.

<table>
<thead>
<tr>
<th>General Agronomy</th>
<th>Crop Science</th>
<th>Soil Science</th>
<th>Climatology</th>
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</thead>
<tbody>
<tr>
<td>Cr</td>
<td>Cr</td>
<td>Cr</td>
<td>Cr</td>
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<td>Agron 212</td>
<td>Agron 406</td>
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<td>Agron 406</td>
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<td>Agron 424</td>
<td>Agron 457</td>
<td>Agron 483</td>
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<td>Agron 464</td>
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<tr>
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<td>Chem 334</td>
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<td>Chem 211</td>
<td>Earth Sci 345</td>
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</table>
Graduate Study Preparation

Crop Science
  Bot. 306, 404; Gen 305; Math 112; Chem 336.

Soil Science
  Agron 577, Chem 321, 322, 323, 336, Geol 355, Math 112

Agricultural Climatology
  Math 112, 213, Phys 113 or 223

Curriculum in Animal Science

Leading to the degree Bachelor of Science. Total credits required, 200, plus six credits of Physical Education.

See also Technical Agriculture for two-year program.

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 hours. Students declaring one minor must include at least 20 hours in the minor. Students declaring two minors must include at least 15 hours 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 Economics, Government, Foreign Languages, Sociology

Plant Sciences, including additional courses in Agronomy, Botany, Horticulture, Plant Pathology.

Students may also elect a department minor or minors in Agronomy, Biochemistry, etc.

For the Animal Science major all students have the following core requirements.

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

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<thead>
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<tr>
<td>Elements of Livestock Production</td>
<td>An Sci 114</td>
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</tr>
<tr>
<td>General Chemistry</td>
<td>Chem 101</td>
<td>4</td>
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<tr>
<td>Prin of Composition</td>
<td>Engl 101</td>
<td>3</td>
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<tr>
<td>General Botany</td>
<td>Bot. 101</td>
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<tr>
<td>Prin of Crop Production</td>
<td>Agron 114A</td>
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<tr>
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<td>Chem 102</td>
<td>4</td>
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<td>Prin of Compositions</td>
<td>Engl 102</td>
<td>3</td>
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<tr>
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<td>Math 101B</td>
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<tr>
<td>Prin of Composition</td>
<td>Engl 103</td>
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<tr>
<td>Algebra &amp; Trig 10</td>
<td>Math 101C</td>
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<td>Prin of Zoology</td>
<td>Zool 101</td>
<td>4</td>
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<tr>
<td>Meat &amp; Meat Processing</td>
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**Sophomore Year**

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<thead>
<tr>
<th>Course</th>
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<tbody>
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<td>Anat of Dom. Animals</td>
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<tr>
<td>Vet Anat 217</td>
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<tr>
<td>or Comparative Anatomy</td>
<td>3</td>
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<tr>
<td>Zool 224</td>
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<tr>
<td>Library Instruction Lib 116</td>
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<tr>
<td>Fund of Soil Science Agron 154A</td>
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<tr>
<td>Meat Animal Eval An Sci 271</td>
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</tr>
<tr>
<td>or Organic Chemistry Chem 334</td>
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<td>Prin of Economics Econ 241</td>
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<tr>
<td>Physiology of Dom Animals Vet Phys 264</td>
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<tr>
<td>Elementary Organic Chem Chem 231</td>
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<tr>
<td>or Applied Animal Breeding An Sci 350</td>
<td>3</td>
</tr>
<tr>
<td>Fund of Speech Sp 319</td>
<td>3</td>
</tr>
<tr>
<td>General Bacteriology Bact 304</td>
<td>5</td>
</tr>
<tr>
<td>American Government Govt 215</td>
<td>3</td>
</tr>
<tr>
<td>Applied Animal Breeding An Sci 351</td>
<td>3</td>
</tr>
<tr>
<td>Fund of Nutrition An Sci 319</td>
<td></td>
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<tr>
<td>Fund of Speech Sp 211</td>
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<tr>
<td>General Bacteriology Bact 304</td>
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<td>Applied Animal Breeding An Sci 351</td>
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<td>Fund of Speech Sp 319</td>
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<td>General Bacteriology Bact 304</td>
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<tr>
<td>American Government Govt 215</td>
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</tr>
<tr>
<td>Applied Animal Breeding An Sci 351</td>
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</tr>
</tbody>
</table>

In addition to the courses listed, each student will be required to include in his freshman and sophomore years six credits of physical education. Students electing to take ROTC may apply credits toward the elective requirement.

**Junior Year**

<table>
<thead>
<tr>
<th>Course</th>
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<tbody>
<tr>
<td>Livestock Judging An Sci 305</td>
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<tr>
<td>Applied Animal Nutrition An Sci 319</td>
<td>3</td>
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<tr>
<td>General Bacteriology Bact 304</td>
<td>5</td>
</tr>
<tr>
<td>American Government Govt 215</td>
<td>3</td>
</tr>
<tr>
<td>Applied Animal Breeding An Sci 351</td>
<td>3</td>
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<tr>
<td>Livestock Judging An Sci 305</td>
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<tr>
<td>Applied Animal Nutrition An Sci 319</td>
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<tr>
<td>General Bacteriology Bact 304</td>
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<td>American Government Govt 215</td>
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<tr>
<td>Applied Animal Breeding An Sci 351</td>
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<tr>
<td>Livestock Judging An Sci 305</td>
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</tr>
<tr>
<td>Applied Animal Nutrition An Sci 319</td>
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<tr>
<td>General Bacteriology Bact 304</td>
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<tr>
<td>American Government Govt 215</td>
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<tr>
<td>Applied Animal Breeding An Sci 351</td>
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<tr>
<td>Livestock Judging An Sci 305</td>
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<tr>
<td>Applied Animal Nutrition An Sci 319</td>
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<tr>
<td>General Bacteriology Bact 304</td>
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</tr>
<tr>
<td>American Government Govt 215</td>
<td></td>
</tr>
<tr>
<td>Applied Animal Breeding An Sci 351</td>
<td></td>
</tr>
</tbody>
</table>

In addition to the courses in the core each student is required to take additional courses to total 16 credits of physical sciences, 18 credits of social sciences and humanities, six of which must be art, history, literature, music, or philosophy, and 12 hours of 400 level Animal Science courses.

**Curriculum in Dairy Science**

Administered by the Department of Animal Science
Leading to the degree Bachelor of Science. Total credits required, 200, plus six credits of physical education.

See also Technical Agriculture for two-year program.

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) Pre-Veterinary students in Dairy Science are requested to take Animal Science 114 and D.F.I. 114.

In addition to the Dairy 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
- **Business**, including additional courses in Economics, Industrial Administration, Psychology, Speech
- **Communications**, including additional courses in English, Speech, Technical Journalism, Telecommunication 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 Economics, Government, Foreign Languages, 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>
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<tr>
<th>FALL QUARTER</th>
<th>WINTER QUARTER</th>
<th>SPRING QUARTER</th>
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</thead>
<tbody>
<tr>
<td>Credits</td>
<td>Credits</td>
<td>Credits</td>
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**Freshman Year**

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<th>Course</th>
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<tr>
<td>Orientation</td>
<td>An. Sci. 110</td>
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<tr>
<td>Elements of Livestock Production</td>
<td>An. Sci. 114</td>
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<tr>
<td>General Chemistry</td>
<td>Chem. 101</td>
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<tr>
<td>Prin. of Composition</td>
<td>Engl. 101</td>
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<td>Prin. of Zoology</td>
<td>Zool. 101</td>
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<tr>
<td>General Chemistry</td>
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<tr>
<td>Elements of Dairy &amp; Food Industry</td>
<td>D.F.I. 114</td>
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<tr>
<td>Prin. of Composition</td>
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**Sophomore Year**

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<td>Econ. 241</td>
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<td>Library Instruction</td>
<td>Lib. 116</td>
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<tr>
<td>or Comparative Anatomy</td>
<td>Zool. 224</td>
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<th>Course</th>
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<td>Stat. 201A or 201</td>
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<td>Vet. Phys. 264</td>
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<td>Dairy Cattle Selection</td>
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**Junior Year**

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<td>Bact. 304</td>
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<td>American Government</td>
<td>Gov't. 215</td>
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<td>D.F.I. 350</td>
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<td>Int. to Genetics</td>
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<td>An. Sci. 331</td>
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<td>Business Corres</td>
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**Senior Year**

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<tr>
<td>Applied Animal Breeding</td>
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<tr>
<td>Milk Prod. &amp; Herd Management</td>
<td>An. Sci. 434</td>
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<td>Milk Secretion</td>
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In addition to the courses listed previously, are additional requirements of 6 credits of art, history, literature, music or philosophy (humanities)*; a total of at least 16 credits in Physical Sciences; six credits of Physical Education.
### Curriculum in Entomology

Administered by the Department of Zoology and Entomology. Leading to the degree Bachelor of Science. Total credits required, 200, plus six credits of physical education.

#### FALL QUARTER

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#### WINTER QUARTER

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<td>P E</td>
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#### SPRING QUARTER

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<td>An Geom and Calc I Math 110</td>
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<td>Principles of Statistics Stat 201</td>
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<td>Gen Ent Zool 274</td>
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#### Freshman Year

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<td>General Botany Bot 101</td>
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<tr>
<td>Concepts of Plant Science Bot 105</td>
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<td>Library Instruction Lib 116</td>
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<tr>
<td>P E</td>
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| Any student may, and especially those preparing for graduate study should, replace Chem 231 with Chem 334 and 335 |

#### Sophomore Year

<table>
<thead>
<tr>
<th>Course</th>
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<tbody>
<tr>
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<td>Intro to Literature Engl 201</td>
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<td>Comparative Anatomy Zool 224</td>
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#### Junior Year

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<td>Vertebrate Embryology Zool 234</td>
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<td>Electives</td>
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| Fund of Speech Sp 211           | 3       |
| Prin of Physiology Zool 355    | 4       |
| Invertebrate Zoology Zool 307   | 4       |

| Electives                      | 7       |

#### Senior Year

<table>
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<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>American Government Govt 215</td>
<td>3</td>
</tr>
<tr>
<td>Animal Ecology Zool 402</td>
<td>4</td>
</tr>
<tr>
<td>Electives</td>
<td>10 Electives</td>
</tr>
</tbody>
</table>

| General Bacteriology Bact. 304  | 5       |
| Elem Plant Physiology Bot 310   | 4       |
| Electives                      | 13      |

| Writing of Sci Papers Engl 414  | 3       |

| Electives                      | 13      |

Ag 104, six months of work experience, is required before graduation. A minimum of 12 credits must be elected from the following groups of courses Engl 330, 354, 363, 364, Hist 311, 312, 313, 324, Phil 260, 350, Ad 365. Other suggested electives Ag Ed 466; Agron 424, An Sci 114, B & B 301, 311; Bot 216, 404; Chem 211, Gen 305, Hist 440, 441, 442, Hort 214, Math 111, 112, 213, Phys. 113, Psych 101, T Jl 225; Zool 311, 324, 572, 576, 577, 578.

Students electing ROTC may apply ROTC credits toward elective requirement.
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 decides to continue may follow the regular Farm Operation curriculum, described in this section, or transfer to another curriculum.

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ag 110</td>
<td></td>
</tr>
<tr>
<td>A E 134</td>
<td></td>
</tr>
<tr>
<td>A E 154</td>
<td></td>
</tr>
<tr>
<td>Agron 114A</td>
<td></td>
</tr>
<tr>
<td>Agron 154B</td>
<td></td>
</tr>
<tr>
<td>An Sci 114</td>
<td></td>
</tr>
<tr>
<td>Econ 130</td>
<td></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>4</td>
</tr>
<tr>
<td>Elements of Farm Management</td>
<td>4</td>
</tr>
<tr>
<td>Total</td>
<td>18</td>
</tr>
</tbody>
</table>

Two-Year Program

Students who complete satisfactorily at least 96 credits in a prescribed program and who 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>WINTER QUARTER</th>
<th>SPRING QUARTER</th>
</tr>
</thead>
<tbody>
<tr>
<td>Credits</td>
<td>Credits</td>
<td>Credits</td>
</tr>
<tr>
<td>Prin of Composition</td>
<td>Engl 101</td>
<td>3</td>
</tr>
<tr>
<td>Prin of Crop Production Agron. 114A</td>
<td>Engl 102 Econ 130</td>
<td>4</td>
</tr>
<tr>
<td>Elem of Livestock Prod An Sci 114</td>
<td>*Ag Math Math 100</td>
<td>5</td>
</tr>
<tr>
<td>Prin of Economics Econ 241</td>
<td>3</td>
<td>Prin of Economics Econ 242</td>
</tr>
<tr>
<td>General Chemistry Chem. 101</td>
<td>Gen 301</td>
<td>3</td>
</tr>
<tr>
<td>Weed Id &amp; Control Bot 216</td>
<td>American Govt Gov 215</td>
<td>3</td>
</tr>
<tr>
<td>Library Instruction Lib. 116</td>
<td>1</td>
<td>Fund of Soil Science Agron 154A</td>
</tr>
<tr>
<td>First Year</td>
<td>Second Year</td>
<td></td>
</tr>
<tr>
<td>In addition to the courses listed above the student will be required to include the following</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
2. 16 credits of free electives
3. 6 credits of physical education.
4. Ag. 110.

*All of the above courses will apply toward a B.S. in Farm Operation except Math. 100.

The Four-Year Major in Farm Operation

Leading to the degree Bachelor of Science. Total credits required, 200, plus six credits of physical education.

In addition to the Farm Operation major, a student must 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 in cooperation with the appropriate department.

### Fall Quarter

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elem of Livestock Prod An Sci 114</td>
<td>4</td>
</tr>
<tr>
<td>General Chemistry Chem 101</td>
<td>4</td>
</tr>
<tr>
<td>Prin of Composition Engl 101</td>
<td>3</td>
</tr>
</tbody>
</table>

### Winter Quarter

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prin of Crop Prod Agron 114A</td>
<td>4</td>
</tr>
<tr>
<td>General Chemistry Chem 102</td>
<td>4</td>
</tr>
<tr>
<td>Prin of Composition Engl 102</td>
<td>3</td>
</tr>
<tr>
<td>Algebra and Trig Math 101B</td>
<td>3</td>
</tr>
</tbody>
</table>

### Spring Quarter

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zoology</td>
<td>5</td>
</tr>
<tr>
<td>Algebra and Trig Math 101C</td>
<td>3</td>
</tr>
<tr>
<td>Prin of Composition Engl 103</td>
<td>3</td>
</tr>
</tbody>
</table>

In addition to the courses listed, each student will be required to include in his freshman and sophomore years Ag 104, 110, and six credits of physical education.

Students electing to take ROTC may apply ROTC credits toward the elective requirement.

### Sophomore Year

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elem Organic Chem Chem 231</td>
<td>5</td>
</tr>
<tr>
<td>Prin of Economics Econ 241</td>
<td>3</td>
</tr>
<tr>
<td>Anat. of Dom Animals Vet Anatomy 217</td>
<td>3</td>
</tr>
<tr>
<td>Library Instruction Lib 116</td>
<td>1</td>
</tr>
<tr>
<td>Phys of Dom Animals Vet Phys 264</td>
<td>3</td>
</tr>
<tr>
<td>Prin. of Economics Econ 242</td>
<td>3</td>
</tr>
<tr>
<td>General Botany Bot 101</td>
<td>4</td>
</tr>
<tr>
<td>Fund of Soil Science Agron 154A</td>
<td>4</td>
</tr>
<tr>
<td>Farm Mgt &amp; Org Econ 330</td>
<td>4</td>
</tr>
<tr>
<td>Fundamentals of Speech Sp 211</td>
<td>3</td>
</tr>
<tr>
<td>Farm Records &amp; Bus Analysis Econ 329 or 326</td>
<td>3</td>
</tr>
<tr>
<td>Accounting 1 1 Ad 384</td>
<td>4</td>
</tr>
</tbody>
</table>

### Junior Year

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fundamentals of Nutrition An Sci 318</td>
<td>4</td>
</tr>
<tr>
<td>Prin of Statistics Stat 201A</td>
<td>3</td>
</tr>
<tr>
<td>Physical Science Elective</td>
<td>3-4</td>
</tr>
<tr>
<td>Applied Animal Nutrition An Sci 319</td>
<td>4</td>
</tr>
<tr>
<td>Soil Fertility Agron 354</td>
<td>4</td>
</tr>
<tr>
<td>Intro Genetics Gen 301</td>
<td>3</td>
</tr>
<tr>
<td>American Government Gov 215</td>
<td>3</td>
</tr>
<tr>
<td>Crop Growth &amp; Culture Agron 315</td>
<td>4</td>
</tr>
<tr>
<td>Prin Animal Breeding 1 An Sci 350</td>
<td>3</td>
</tr>
<tr>
<td>or Agron 424</td>
<td>3</td>
</tr>
</tbody>
</table>
Senior Year

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>General Bacteriology Bact. 304A</td>
<td>5</td>
</tr>
<tr>
<td>Rural Inst &amp; Org Soc 200</td>
<td>4</td>
</tr>
<tr>
<td>Farm Operation</td>
<td>4</td>
</tr>
<tr>
<td>Ag. 450</td>
<td></td>
</tr>
<tr>
<td>Appraisal of Farm Real Est Econ. 440</td>
<td></td>
</tr>
<tr>
<td>or Ag. Law</td>
<td></td>
</tr>
<tr>
<td>Econ 451</td>
<td>3</td>
</tr>
<tr>
<td>(52 electives)</td>
<td></td>
</tr>
</tbody>
</table>

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

1. Six credits elected from art, history, literature, music, and philosophy
4. Three to four credits from Biochem. 301, Bot 310.
5. 52 free electives

Curriculum in Fisheries and Wildlife Biology

Administered by the Department of Zoology and Entomology.

Leading to the degree Bachelor of Science with a minor in Botany. A second minor is possible. Total credits required, 200, plus six credits of physical education.

<table>
<thead>
<tr>
<th>FALL QUARTER</th>
<th>WINTER QUARTER</th>
<th>SPRING QUARTER</th>
</tr>
</thead>
<tbody>
<tr>
<td>Credits</td>
<td>Credits</td>
<td>Credits</td>
</tr>
<tr>
<td><strong>Freshman Year</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>General Botany Bot 101</td>
<td>4</td>
<td>Plant Taxonomy Bot. 306</td>
</tr>
<tr>
<td>Prin. of Composition Engl. 101</td>
<td>3</td>
<td>Prin. of Composition Engl. 102</td>
</tr>
<tr>
<td>The Animal Kingdom Zool. 102</td>
<td>5</td>
<td>Elem Plant Physiology Bot. 310</td>
</tr>
<tr>
<td>Technical Lecture Zool. 100</td>
<td>R</td>
<td>P. E.</td>
</tr>
<tr>
<td>P. E.</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td><strong>Sophomore Year</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dendrology Bot. 356</td>
<td>4</td>
<td>Fund. of Soil Science Agron. 154A</td>
</tr>
<tr>
<td>General Chemistry Chem. 101</td>
<td>4</td>
<td>Comparative Anatomy Zool. 224</td>
</tr>
<tr>
<td>Intro. to Geology Geol. 100</td>
<td>3</td>
<td>Prin. of Economics Econ. 242</td>
</tr>
<tr>
<td>General Entomology Zool. 274</td>
<td>4</td>
<td>Intro to Sociology Soc. 134</td>
</tr>
<tr>
<td>Library Instruction Lib. 116</td>
<td>1</td>
<td>Ornithology Zool. 340</td>
</tr>
<tr>
<td>P. E.</td>
<td>1</td>
<td>P. E.</td>
</tr>
<tr>
<td><strong>Junior Year</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gen. Plant Ecology Bot. 424</td>
<td>3</td>
<td>Intro Genetics Gen. 301</td>
</tr>
<tr>
<td>Elem. Organic Chem Chem. 231</td>
<td>5</td>
<td>Fund of Speech Sp 211</td>
</tr>
<tr>
<td>General Physics Phys 111</td>
<td>4</td>
<td>Writing of Scient Papers Eng. 414</td>
</tr>
<tr>
<td>Mammalogy Zool. 447</td>
<td>4</td>
<td>or Publicity and Public Relations T. JI. 225</td>
</tr>
<tr>
<td>General Bacteriology Bact. 304</td>
<td>5</td>
<td>Fund. of Limnology Zool. 405</td>
</tr>
<tr>
<td>Gen. Phys. Phys 112</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Prin. of Physiology Zool. 355</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Zool 464</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>Electives</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Curricular Outline

| Semester               | Credits | Senior Year
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Fall Quarter</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Forest Conservation</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>For. 400</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Animal Ecology</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Zool. 402</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fisheries Management</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Zool. 465</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Electives</td>
<td>5</td>
<td></td>
</tr>
</tbody>
</table>

| Winter Quarter         |         |              |
| Forest Conservation    | 3       |              |
| Business Correspondence|         |              |
| Engl. 404              |         |              |
| American Government    | 3       |              |
| Govt. 215              |         |              |
| Vertebrate Embryology  | 5       |              |
| Zool. 234              |         |              |
| Electives              | 7       |              |

| **Spring Quarter**     |         |              |
| Soil Erosion and Cons. | 3       |              |
| Agron. 464             |         |              |
| Invertebrate Zoology   | 4       |              |
| Zool. 307              |         |              |
| Wildlife Techniques    | 4       |              |
| Zool. 448              |         |              |
| Electives              | 6       |              |

Ag. 104, six months of work experience, is required before graduation. A minimum of 9 credits must be elected from the following courses: Engl. 201, 330, 354, 363, 364; Hist. 311, 312, 313, 324; Phil. 260. Other suggested electives: Bot. 203, 564; C E. 315; For. 101, 301, 491; Govt. 471, 478; Psych. 101; Phys. 113; Zool. 303, 306, 311, 470, 503, 505, 507. Students electing ROTC may apply ROTC credits toward elective requirement. Students preparing for graduate college should take one year of a foreign language. Additional mathematics, physics and chemistry are also helpful.

### Curricular Outline

**Curriculum in Food Technology**

With options in Dairy Technology and Business. Administered by the Department of Dairy and Food Industry. Leading to the degree Bachelor of Science. Total credits required, 200, plus six credits of physical education. In addition to the department major (or option), the student may declare one minor. This declaration must be made prior to the completion of 140 credits and must include at least 20 credits in the minor subject.

**Food Technology**

In accordance with recommended professional standards, the Food Technology curriculum combines a broad foundation in the biological and physical sciences, communications and mathematics with applications to the processing, preservation, sanitation, storage and marketing of food products. It is for students interested in management careers in food manufacturing, research and development, quality control, and marketing and in the businesses providing the food industry with equipment, supplies and services.

**Option in Dairy Technology**

For students interested in management careers specifically in dairy products manufacturing and marketing, research and development or in the businesses providing the dairy industry with equipment, supplies and services.

**Option in Business**

For students interested in procurement and sales management, marketing and distribution, and in the fiscal and economic aspects of the food industries.

**Combined Programs in Food Technology and Engineering**

Students who wish to combine education in mechanical, chemical or agricultural engineering with that in Food Technology or Dairy Technology may arrange special 5-year programs leading to Bachelor of Science degrees in Food Technology or Dairy Technology plus one of the engineering fields.
### Core Requirements

#### 1 Basic Subjects

<table>
<thead>
<tr>
<th>Communications</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Principles of Composition</td>
<td>9</td>
</tr>
<tr>
<td>Engl. 101, 102, 103</td>
<td></td>
</tr>
<tr>
<td>Fundamentals of Speech</td>
<td>3</td>
</tr>
<tr>
<td>Speech 211</td>
<td></td>
</tr>
<tr>
<td>Publicity and Public Relations</td>
<td>3</td>
</tr>
<tr>
<td>Tech. Jl. 225</td>
<td></td>
</tr>
<tr>
<td>Library Instruction</td>
<td>1</td>
</tr>
<tr>
<td>Lib. 116</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Physical Sciences</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>General Physics</td>
<td>8</td>
</tr>
<tr>
<td>Phys 111, 112</td>
<td></td>
</tr>
<tr>
<td>General Chemistry</td>
<td>8</td>
</tr>
<tr>
<td>Chem 101, 102</td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Biological Sciences</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>General Bacteriology</td>
<td>5</td>
</tr>
<tr>
<td>Bact 304</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Mathematics and Statistics</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Algebra and Trigonometry</td>
<td>10</td>
</tr>
<tr>
<td>Math 101, 102</td>
<td></td>
</tr>
<tr>
<td>Principles of Statistics</td>
<td>3</td>
</tr>
<tr>
<td>Stat 201A</td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Social Sciences</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Principles of Economics</td>
<td>8</td>
</tr>
<tr>
<td>Econ 241, 242</td>
<td></td>
</tr>
<tr>
<td>American Government</td>
<td>3</td>
</tr>
<tr>
<td>Govt. 215</td>
<td></td>
</tr>
<tr>
<td>Elective</td>
<td>3</td>
</tr>
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</table>

<table>
<thead>
<tr>
<th>Humanities</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>6</td>
</tr>
</tbody>
</table>

#### 2 Departmental Subjects

<table>
<thead>
<tr>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elem. of Dairy and Food Ind</td>
</tr>
<tr>
<td>DFI 114</td>
</tr>
<tr>
<td>Food Chemistry</td>
</tr>
<tr>
<td>DFI 349</td>
</tr>
<tr>
<td>Dairy Microbiology</td>
</tr>
<tr>
<td>DFI 350</td>
</tr>
<tr>
<td>Food Preservation</td>
</tr>
<tr>
<td>DFI 412</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water, Food and Milk Sanitation</td>
</tr>
<tr>
<td>DFI 414</td>
</tr>
<tr>
<td>Food Processing Equipment</td>
</tr>
<tr>
<td>DFI 491, 492, 493</td>
</tr>
<tr>
<td>Manag of Food Processing Plants</td>
</tr>
<tr>
<td>DFI 494, 495</td>
</tr>
</tbody>
</table>

### Food Technology

Students who intend to complete the curriculum which meets the standards recommended by the Institute of Food Technologists will, with their adviser, plan a program which, in addition to the core requirements listed above, must include strong sequences of courses in chemistry, biochemistry, and mathematics (including calculus). To provide adequate professional preparation they should also include courses in botany, zoology, genetics, and in the processing and marketing of animal and plant commodities. This curriculum is excellent preparation for graduate study as well as for professional careers in the food industry.

### Dairy Technology

Students choosing the dairy technology option will, in addition to meeting the core requirements, plan a program which includes courses in dairy chemistry and dairy products technology. This should be supplemented by courses in economics and industrial administration.

### Business

Students in the business option will, in addition to meeting the core requirements, plan a program which includes courses in industrial administration (including accounting), economics and communications.

In addition to the courses listed, the student must also include DFI 110.

Students electing to take ROTC may apply ROTC credits toward the elective requirements.
Curriculum in Forestry

With options in Forest Management and Forest Products.
Leading to the degree Bachelor of Science. Total credits required, 212, plus six credits of physical education.

<table>
<thead>
<tr>
<th>FALL QUARTER</th>
<th>WINTER QUARTER</th>
<th>SPRING QUARTER</th>
</tr>
</thead>
<tbody>
<tr>
<td>Credits</td>
<td>Credits</td>
<td>Credits</td>
</tr>
<tr>
<td>Freshman Year</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prin of Composition Engl 101</td>
<td>Prin of Composition Engl 102</td>
<td>Prin of Composition Engl 103</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Alg &amp; Trig I</td>
<td>Alg &amp; Trig II</td>
<td>Anal Geom &amp; Calc I</td>
</tr>
<tr>
<td>Math 101 *</td>
<td>Math 102</td>
<td>Math 110</td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>General Chemistry Chem 101</td>
<td>General Chemistry Chem 102</td>
<td>Intro to Plant Science Bot 210</td>
</tr>
<tr>
<td>4</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Intro to Forestry For 101</td>
<td>The Animal Kingdom For 102</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* See 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
<table>
<thead>
<tr>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prin of Economics Econ 241</td>
</tr>
<tr>
<td>3</td>
</tr>
<tr>
<td>Wood Technology I For 380</td>
</tr>
<tr>
<td>4</td>
</tr>
<tr>
<td>Library Instruction Lib 116A</td>
</tr>
<tr>
<td>1</td>
</tr>
<tr>
<td>American Government Govt 215</td>
</tr>
<tr>
<td>3</td>
</tr>
</tbody>
</table>

In addition to the courses specified, each student is required to include the following:
For 110 and six credits of physical education, plus 20 credits in courses from the following groups

I Math 111, 112, 213, 304, 305,
Phys 111, 112, 113, 221, 222, 223,
Chem 103, 211, 231, 334, 335,
Geol 100, Bot 306, 356
One course in physics and one in organic chemistry must be included

II 6 additional credits in social sciences: economics, government, psychology, sociology

III 9 credits in humanities: art, history, literature, music, philosophy

It is recommended that 23 credits from the foregoing groups (exclusive of physical education) be included in the freshman and sophomore years

Junior Year
<table>
<thead>
<tr>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Forest Economics For 470</td>
</tr>
<tr>
<td>5</td>
</tr>
</tbody>
</table>

Senior Year
<table>
<thead>
<tr>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Writing of Reports and Technical Papers Engl 414A</td>
</tr>
<tr>
<td>3</td>
</tr>
</tbody>
</table>

In addition to the above core curriculum, the student is required to take the following courses in his selected option.

### Forest Management Option

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surveying</td>
<td></td>
</tr>
<tr>
<td>CEE 210 Jr F</td>
<td>5</td>
</tr>
<tr>
<td>Applied Entomology</td>
<td></td>
</tr>
<tr>
<td>Zool 376 Jr F</td>
<td>4</td>
</tr>
<tr>
<td>Forest Soils</td>
<td></td>
</tr>
<tr>
<td>Agron 357 Jr W</td>
<td>5</td>
</tr>
<tr>
<td>Silviculture</td>
<td></td>
</tr>
<tr>
<td>For 302 Jr S</td>
<td>4</td>
</tr>
<tr>
<td>Forest Photogrammetry</td>
<td></td>
</tr>
<tr>
<td>For 445 Jr S</td>
<td>4</td>
</tr>
<tr>
<td>Dynamics of Forest Stands</td>
<td></td>
</tr>
<tr>
<td>For 442 Sr W</td>
<td>3</td>
</tr>
<tr>
<td>Forest Pathology</td>
<td></td>
</tr>
<tr>
<td>Bot 416 Sr S</td>
<td>4</td>
</tr>
<tr>
<td>Non-Timber Forest Resources</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td></td>
</tr>
<tr>
<td>Minor</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td></td>
</tr>
<tr>
<td>Practical Work</td>
<td></td>
</tr>
<tr>
<td>Ag 104</td>
<td>R</td>
</tr>
<tr>
<td>Electives</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td></td>
</tr>
</tbody>
</table>

### Forest Products Option

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wood-Liquid Relations and Specific Gravity</td>
<td></td>
</tr>
<tr>
<td>For 389 Jr F</td>
<td>3</td>
</tr>
<tr>
<td>Physical Properties of Wood</td>
<td></td>
</tr>
<tr>
<td>For 488 Jr W</td>
<td>4</td>
</tr>
<tr>
<td>Wood Deterioration</td>
<td></td>
</tr>
<tr>
<td>Bot 417 Jr W</td>
<td>4</td>
</tr>
<tr>
<td>Seasoning and Preservation of Wood</td>
<td></td>
</tr>
<tr>
<td>For 386 Jr S</td>
<td>3</td>
</tr>
<tr>
<td>Chemical Processing of Wood</td>
<td></td>
</tr>
<tr>
<td>For 481 Sr W</td>
<td>3</td>
</tr>
<tr>
<td>Mechanical Processing and Wood Finishing</td>
<td></td>
</tr>
<tr>
<td>For 487 Sr S</td>
<td>4</td>
</tr>
<tr>
<td>Minor</td>
<td></td>
</tr>
<tr>
<td>35</td>
<td></td>
</tr>
<tr>
<td>Practical Work</td>
<td></td>
</tr>
<tr>
<td>Ag 104</td>
<td>R</td>
</tr>
<tr>
<td>Electives</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td></td>
</tr>
</tbody>
</table>

### 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 35 credits. Details on the composition and objectives of the various minors are available from advisers. Minors are designed either to supplement the students' 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 - 35 credits**
- Wood science and technology
- Timber products conversion
- Timber products business

A student completing one of the three R.O.T.C. programs may apply up to 9 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, 200, plus six credits of physical education.

See also *Technical Agriculture* for two-year program.
<table>
<thead>
<tr>
<th>FALL QUARTER</th>
<th>WINTER QUARTER</th>
<th>SPRING QUARTER</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Freshman Year</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>General Botany</td>
<td>4</td>
<td>Algebra and Trig</td>
</tr>
<tr>
<td>Bot 101</td>
<td></td>
<td>Math 101C</td>
</tr>
<tr>
<td>Prin of Composition</td>
<td>3</td>
<td>The Plant Kingdom</td>
</tr>
<tr>
<td>Engl 101</td>
<td></td>
<td>Bot 202</td>
</tr>
<tr>
<td>Prin of Horticulture</td>
<td>3</td>
<td>General Chemistry</td>
</tr>
<tr>
<td>Hort 114A</td>
<td></td>
<td>Chem 101</td>
</tr>
<tr>
<td>Horticulture Laboratory</td>
<td>1</td>
<td>Prin of Composition</td>
</tr>
<tr>
<td>Hort 114B</td>
<td></td>
<td>Engl 102</td>
</tr>
<tr>
<td>*Algebra and Trig</td>
<td>3</td>
<td>Greenhouse Methods</td>
</tr>
<tr>
<td>Math 101B</td>
<td></td>
<td>Hort 154</td>
</tr>
</tbody>
</table>

In addition to the courses listed, each student will be required to include in the freshman and sophomore years, six credits of physical education. The student will also take Hort 110 and Ag. 104 (to be completed before the senior year).

Students electing to take ROTC may apply ROTC credits toward the elective requirement.

*See Mathematics for description of beginning courses. Course selected should be consistent with preparation.*

<table>
<thead>
<tr>
<th>Sophomore Year</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Ag Meteorology</td>
<td>3</td>
<td>Elem Organic Chemistry</td>
</tr>
<tr>
<td>Agron 206</td>
<td></td>
<td>Chem 231</td>
</tr>
<tr>
<td>Principles of Economics</td>
<td>3</td>
<td>Principles of Economics</td>
</tr>
<tr>
<td>Econ 241</td>
<td></td>
<td>Econ 242</td>
</tr>
<tr>
<td>Principles of Zoology</td>
<td>5</td>
<td>Plant Propagation</td>
</tr>
<tr>
<td>Zool 101</td>
<td></td>
<td>Hort 214</td>
</tr>
<tr>
<td>or</td>
<td></td>
<td></td>
</tr>
<tr>
<td>The Animal Kingdom</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Zool 102</td>
<td></td>
<td></td>
</tr>
<tr>
<td>General Physics</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Phys 111</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Library Instruction</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Lib 116</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Junior Year</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Garden Flowers</td>
<td>3</td>
<td>General Bacteriology</td>
</tr>
<tr>
<td>Hort 244A</td>
<td></td>
<td>Bact 304</td>
</tr>
<tr>
<td>Orcharding</td>
<td>3</td>
<td>Elem, Plant Physiology</td>
</tr>
<tr>
<td>Hort 321</td>
<td></td>
<td>Bot 310</td>
</tr>
<tr>
<td>Systematic Horticulture I</td>
<td>3</td>
<td>Introductory Genetics</td>
</tr>
<tr>
<td>Hort 490</td>
<td></td>
<td>Gen 301</td>
</tr>
<tr>
<td>Applied Entomology</td>
<td>4</td>
<td>Systematic Horticulture II</td>
</tr>
<tr>
<td>Zool 376</td>
<td></td>
<td>Hort 491</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Senior Year</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Seminar</td>
<td>1</td>
<td>Prin of Plant Pathology</td>
</tr>
<tr>
<td>Hort 401</td>
<td></td>
<td>Bact 407</td>
</tr>
<tr>
<td>Systematic Horticulture III</td>
<td>3</td>
<td>Seminar</td>
</tr>
<tr>
<td>Hort 492</td>
<td></td>
<td>Hort 402</td>
</tr>
<tr>
<td>*Humanities</td>
<td>3</td>
<td>Marketing Horticultural Crops</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Hort 414</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Systematic Horticulture IV</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Hort 493</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, 244A, 492, 493; Bot. 407.
Add to basic curriculum: For. 301; Bot. 356, 404, 416; T. Jl. 225; I. Ad. 384; Hort. 305, 314.
Electives: (40 credits) Bot. 216; I. Ad. 365C, 385; Psych. 250; L. A. 112, 113, 206; T. Jl. 325.

Floriculture
Add to basic curriculum: Hort. 247B, 305, 314, 446, 447; Geol. 100.
Electives (37 credits) Hort. 467; Psych. 250; I. A. 112, 113; Arch. 214;
Bot. 216, 404.

Fruit or Vegetable Crops
Add to basic curriculum Hort. 422, 467; Agron. 114A.
Electives: (43 credits) Hort. 514; Psych. 250; Bot. 216, 404, 438; Geol. 100; Hist. 440, 441, 442; I. Ad. 365C, econ. 335.

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. 314, 446, 467.

Science (for those preparing for graduate study)
Omit from basic curriculum Chem. 231; Psych. 101; Stat. 201A.
Add to basic curriculum Chem. 103, 334; Hort. 467, 514; Phys. 112;
Stat. 201.
Electives: (37 credits) Chem. 211, 335; Gen. 401; Geol. 100; F. L. 231,
232, 233; Math. 102, 110, 111, 112; Phys. 113; Bot. 404.

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, 314; Soc. 134;
T. Jl. 225.

Curriculum in Industrial Education

With options in Teaching and Industry.
Administered by the Department of Education.

Leading to the degree Bachelor of Science. Total credits required, 202, plus six credits of physical education.

Teaching Option

Provides preparation for teachers of industrial arts, or trades and industry, or both.

Industry Option

This option is available to those students who do not wish to meet the requirements for a teaching certificate. The work of the freshman and sophomore years is the same for all students. Students pursuing the industrial option may omit the professional courses required for a certificate and take other courses in their place. The program of the junior and senior years is planned to meet the needs of the individual student.

Students who complete satisfactorily at least 96 credits in this option and who find it impracticable to complete a four year program will receive a certificate in industrial ed-
ducation showing the completion of two years of work.

Students in this program generally find employment in industry. They may enter such positions as personnel work, selling, drafting and design, contracting and construction, maintenance and production methods.

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

**Freshman Year**

<table>
<thead>
<tr>
<th>Drawnig and Projection</th>
<th>Freshman Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>E Gr 131</td>
<td>Working Drawings and Applied Graphics</td>
</tr>
<tr>
<td>Prin of Composition</td>
<td>E Gr 133</td>
</tr>
<tr>
<td>Eng 101</td>
<td>Prin of Composition</td>
</tr>
<tr>
<td>Tech and Appl of</td>
<td>Engl 103</td>
</tr>
<tr>
<td>Finishing Mater</td>
<td>Intro to Ind Ed</td>
</tr>
<tr>
<td>1 Ed 105</td>
<td>Adv Tech of Wood</td>
</tr>
<tr>
<td>Introduction to Sociology</td>
<td>Fabrication</td>
</tr>
<tr>
<td>Soc 134</td>
<td>1 Ed 205</td>
</tr>
<tr>
<td>Algebra and Trig I</td>
<td>Basic Metal Processes</td>
</tr>
<tr>
<td>Math 101</td>
<td>1 Ed 254</td>
</tr>
<tr>
<td></td>
<td>General Psych</td>
</tr>
<tr>
<td></td>
<td>Psych 101</td>
</tr>
</tbody>
</table>

In addition to the courses listed, each student will be required to include in his freshman and sophomore years Ed 110, and six credits of physical education.

Students electing to take ROTC may apply ROTC credits toward the elective requirement.

**Sophomore Year**

<table>
<thead>
<tr>
<th>Principles of Economics</th>
<th>Principles of Economics</th>
<th>Electricity II</th>
</tr>
</thead>
<tbody>
<tr>
<td>Econ 241</td>
<td>Econ 242</td>
<td>1 Ed 253</td>
</tr>
<tr>
<td>Sheet Metal Fabrication</td>
<td>Machine Metals I</td>
<td>3</td>
</tr>
<tr>
<td>1 Ed 255</td>
<td>1 Ed 256</td>
<td>Ed 204</td>
</tr>
<tr>
<td>General Botany</td>
<td>Electricity I</td>
<td>3</td>
</tr>
<tr>
<td>Bot 101</td>
<td>1 Ed 251</td>
<td>Machine Constr</td>
</tr>
<tr>
<td>Power Mechanics I</td>
<td>Principles of Zoology</td>
<td>A E 359</td>
</tr>
<tr>
<td>1 Ed 261</td>
<td>Zool 101</td>
<td>Freehand Drawing I</td>
</tr>
<tr>
<td>General Chemistry</td>
<td>General Chemistry</td>
<td>Arch 231</td>
</tr>
<tr>
<td>Chem 101</td>
<td>Chem 102</td>
<td>2</td>
</tr>
<tr>
<td>Library Instruction</td>
<td>Lib 116</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Students must elect, in addition to the courses outlined in the curriculum, one three credit course in either the physical sciences, physics, chemistry or geology or biological sciences botany, zoology or genetics and one three credit course in the communicative arts speech, English, journalism

**Junior and Senior Years**

<table>
<thead>
<tr>
<th>History of the American Nation</th>
<th>History of the American Nation</th>
<th>History of the American Nation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hist 321</td>
<td>Hist 322</td>
<td>Hist 323</td>
</tr>
<tr>
<td>Electronics I</td>
<td>School Shop Safety</td>
<td>Machine Metals II</td>
</tr>
<tr>
<td>1 Ed 357</td>
<td>Education</td>
<td>1 Ed 356</td>
</tr>
<tr>
<td>General Physics</td>
<td>1 Ed 350</td>
<td>Fund of Speech</td>
</tr>
<tr>
<td>Phys 111</td>
<td>American Government</td>
<td>Sp 211</td>
</tr>
<tr>
<td>Crafts</td>
<td>Govt 215</td>
<td>Shop Planning and Org</td>
</tr>
<tr>
<td>1 Ed 207</td>
<td>Ornamental Metal Design and Processes</td>
<td>1 Ed 409</td>
</tr>
</tbody>
</table>

*Hist 311, 312, and 313 may be taken in place of this sequence*

In addition to the courses listed previously a student electing the Teaching Option is required to take the courses listed following. The student electing the Industry Option must complete the work listed previously and elect the balance of his program from the areas listed on the following page, depending upon his education objective.
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, 200, plus six credits of physical education.

Landscape Architecture

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

**Freshman Year**

<table>
<thead>
<tr>
<th>Design Fundamentals</th>
<th>Design Fundamentals</th>
<th>Arch Design &amp; Anal I</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arch 111</td>
<td>Arch 112</td>
<td>Arch 113</td>
</tr>
<tr>
<td>General Botany</td>
<td>General Chemistry</td>
<td>Engr Graphics</td>
</tr>
<tr>
<td>Bot 101</td>
<td>Chem 101</td>
<td>Engr Gr. 143</td>
</tr>
<tr>
<td>Prin of Composition</td>
<td>Prin of Composition</td>
<td>Plant Taxonomy</td>
</tr>
<tr>
<td>Eng 101</td>
<td>Eng 102</td>
<td>Bot 306</td>
</tr>
<tr>
<td>Orientation in L A</td>
<td>L A Drawing</td>
<td>Prin of Composition</td>
</tr>
<tr>
<td>L A 110</td>
<td>L A 112</td>
<td>Eng 103</td>
</tr>
<tr>
<td>Algebra &amp; Trig I</td>
<td>Algebra &amp; Trig II</td>
<td>Landscape Perception</td>
</tr>
<tr>
<td>Math 101</td>
<td>Math 102</td>
<td>L A 113</td>
</tr>
</tbody>
</table>

In addition to the courses listed, each student will be required to include in his freshman and sophomore years six credits of physical education.

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

**Sophomore Year**

<table>
<thead>
<tr>
<th>Fund of Soil Science</th>
<th>Mapping, Computations, &amp; Land Surveying</th>
<th>Survey of Art</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agron. 154A</td>
<td>C E 214</td>
<td>A, A. 384</td>
</tr>
<tr>
<td>Arch Design &amp; Anal II</td>
<td>Intro to Geology</td>
<td>Theory of Landscape</td>
</tr>
<tr>
<td>Arch 210</td>
<td>Geol 100</td>
<td>Design</td>
</tr>
<tr>
<td>Elementary Surveying</td>
<td>American Government</td>
<td>L A 213</td>
</tr>
<tr>
<td>C E 211</td>
<td>Govt 215</td>
<td>Plant Materials</td>
</tr>
<tr>
<td>History of L A</td>
<td>History of L A</td>
<td>L A 233</td>
</tr>
<tr>
<td>L A 201</td>
<td>L A 202</td>
<td>Details of Construction</td>
</tr>
<tr>
<td>Plant Materials</td>
<td>Plant Materials</td>
<td>L A 301</td>
</tr>
<tr>
<td>L A 231</td>
<td>L A 232</td>
<td>Publicity &amp; Public</td>
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<tr>
<td>Library Instruction</td>
<td>Intro to Sociology</td>
<td>Relations</td>
</tr>
<tr>
<td>Lib 116</td>
<td>Soc 134</td>
<td>T JI. 225</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Intro to Physical Planning</td>
</tr>
<tr>
<td></td>
<td></td>
<td>U P 253</td>
</tr>
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</table>
### Colleges and Curricula

#### FAll QUARTER Credits

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
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<tbody>
<tr>
<td>Prin of Economics</td>
<td>3</td>
</tr>
<tr>
<td>Econ 241</td>
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<tr>
<td>Landscape Design</td>
<td>3</td>
</tr>
<tr>
<td>L A 311</td>
<td></td>
</tr>
<tr>
<td>Planting Design</td>
<td>3</td>
</tr>
<tr>
<td>L A 334</td>
<td></td>
</tr>
<tr>
<td>Travel &amp; Practice</td>
<td>R</td>
</tr>
<tr>
<td>L A 341 or 342</td>
<td></td>
</tr>
<tr>
<td>Prin. of Statistics</td>
<td>3</td>
</tr>
<tr>
<td>Stat 201A</td>
<td></td>
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<tr>
<td>Urban Problems and Planning Goals U P 361</td>
<td>3</td>
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<tr>
<td>Minor</td>
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</tbody>
</table>

#### WINTER QUARTER Credits

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
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<tbody>
<tr>
<td>Prin of Economics</td>
<td>3</td>
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<tr>
<td>Econ 242</td>
<td></td>
</tr>
<tr>
<td>Details of Construction</td>
<td>3</td>
</tr>
<tr>
<td>L A 302</td>
<td></td>
</tr>
<tr>
<td>Landscape Design</td>
<td>3</td>
</tr>
<tr>
<td>L A 312</td>
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<tr>
<td>Cultural Anthropology</td>
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<tr>
<td>Soc 218</td>
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#### SPRING QUARTER Credits

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
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<tbody>
<tr>
<td>Photogrammetry and Photo-Interpretation For 447</td>
<td>3</td>
</tr>
<tr>
<td>Landscape Design</td>
<td>3</td>
</tr>
<tr>
<td>L A 313</td>
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<tr>
<td>Planting Design</td>
<td>3</td>
</tr>
<tr>
<td>L A 335</td>
<td></td>
</tr>
<tr>
<td>Fund of Speech</td>
<td>3</td>
</tr>
<tr>
<td>Sp 211</td>
<td></td>
</tr>
<tr>
<td>Elective</td>
<td>3</td>
</tr>
<tr>
<td>Minor</td>
<td>3</td>
</tr>
</tbody>
</table>

#### Junior Year

**Collaborative Trans Development**
- **C E 350**
- **Landscape Service**
  - **Hort. 305**
  - **L A 303**
  - **Travel & Practice**
    - **L A 341 or 342**
  - **Public Recreational Fac L A 404**
  - **Adv Landscape Design L A 411**
  - **Minor**

**Credits**

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engr in City Plan</td>
<td>3</td>
</tr>
<tr>
<td>C E 404</td>
<td></td>
</tr>
<tr>
<td>Govt. &amp; Conservation Policies</td>
<td>3</td>
</tr>
<tr>
<td>Govt 474</td>
<td></td>
</tr>
<tr>
<td>Planting Design</td>
<td>3</td>
</tr>
<tr>
<td>L A 336</td>
<td></td>
</tr>
<tr>
<td>Adv Landscape Design</td>
<td>3</td>
</tr>
<tr>
<td>L A 412</td>
<td></td>
</tr>
<tr>
<td>Minor</td>
<td>5</td>
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</tbody>
</table>

**Electives** to include two credits of biological science and four credits of physical science Ag 104, six months of work experience, is required before graduation.

### Urban Planning

#### FAll QUARTER Credits

<table>
<thead>
<tr>
<th>Course</th>
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</tr>
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<tbody>
<tr>
<td>Design I Arch 111</td>
<td>2</td>
</tr>
<tr>
<td>Prin of Composition Engl 101</td>
<td>3</td>
</tr>
<tr>
<td>Intro to Geology Geol 100</td>
<td>3</td>
</tr>
<tr>
<td>Algebra &amp; Trig. I Math 101</td>
<td>5</td>
</tr>
<tr>
<td>Intro. to Sociology Soc. 134</td>
<td>3</td>
</tr>
<tr>
<td>Orientation in U P U P 110</td>
<td>R</td>
</tr>
</tbody>
</table>

#### WINTER QUARTER Credits

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design I Arch 112</td>
<td>2</td>
</tr>
<tr>
<td>Prin of Composition Engl 102</td>
<td>3</td>
</tr>
<tr>
<td>L A Drawing</td>
<td>3</td>
</tr>
<tr>
<td>L A 112</td>
<td></td>
</tr>
<tr>
<td>Algebra &amp; Trig II Math 102</td>
<td>5</td>
</tr>
<tr>
<td>General Physics Math 102</td>
<td>5</td>
</tr>
<tr>
<td>Physics 111</td>
<td>4</td>
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<tr>
<td>Orientation in U P U P 110</td>
<td>R</td>
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**Credits**

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
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<tbody>
<tr>
<td>Arch 113</td>
<td>2</td>
</tr>
<tr>
<td>Arch Graphics 3</td>
<td>2</td>
</tr>
<tr>
<td>Engr Gr 143</td>
<td>2</td>
</tr>
<tr>
<td>Prin of Composition Engl 103</td>
<td>3</td>
</tr>
<tr>
<td>Landscape Perception L A 113</td>
<td>3</td>
</tr>
</tbody>
</table>

**In addition to the courses listed, each student will be required to include in his freshman and sophomore years six credits of physical education. Students electing ROTC may apply ROTC credits toward the elective requirements.**

#### Sophomore Year

<table>
<thead>
<tr>
<th>Course</th>
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</thead>
<tbody>
<tr>
<td>Design II Arch 211</td>
<td>3</td>
</tr>
<tr>
<td>Elementary Surveying C E 211A</td>
<td>3</td>
</tr>
<tr>
<td>Prin of Economics Econ 241</td>
<td>3</td>
</tr>
<tr>
<td>Mapping, Computations, &amp; Land Surveying C E 214</td>
<td>3</td>
</tr>
<tr>
<td>Prin of Economics Econ 242</td>
<td>3</td>
</tr>
<tr>
<td>State &amp; Local Govt. Govt 310</td>
<td>3</td>
</tr>
<tr>
<td>Theory of Landscape Design L A 213</td>
<td>3</td>
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</table>

**Credits**

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>State &amp; Local Govt. Govt 310</td>
<td>3</td>
</tr>
<tr>
<td>Theory of Landscape Design L A 213</td>
<td>3</td>
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</tbody>
</table>
### FALL QUARTER

<table>
<thead>
<tr>
<th>Course</th>
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<tbody>
<tr>
<td>American Government</td>
<td>3</td>
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<tr>
<td>Govt 215</td>
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</tr>
<tr>
<td>Library Instruction</td>
<td>1</td>
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<tr>
<td>Lib 116</td>
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<tr>
<td>Humanities or Mathematics</td>
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### WINTER QUARTER

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
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<tbody>
<tr>
<td>Functions of American Government</td>
<td></td>
</tr>
<tr>
<td>Govt 305</td>
<td>3</td>
</tr>
<tr>
<td>Intro to Physical Planning</td>
<td></td>
</tr>
<tr>
<td>U P 253</td>
<td>3</td>
</tr>
<tr>
<td>Humanities or Mathematics</td>
<td>3,4,5</td>
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### SPRING QUARTER

<table>
<thead>
<tr>
<th>Course</th>
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<tbody>
<tr>
<td>Details of Construction</td>
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<tr>
<td>L A 301</td>
<td></td>
</tr>
<tr>
<td>General Physics</td>
<td>4</td>
</tr>
<tr>
<td>Physics 112</td>
<td></td>
</tr>
<tr>
<td>Humanities</td>
<td>3</td>
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</table>

### Junior Year

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Collaborative Trans Development</td>
<td></td>
</tr>
<tr>
<td>C E 350</td>
<td>3</td>
</tr>
<tr>
<td>Landscape Design</td>
<td>3</td>
</tr>
<tr>
<td>L A 311</td>
<td></td>
</tr>
<tr>
<td>Travel &amp; Practice</td>
<td>R</td>
</tr>
<tr>
<td>L A 341 or 342</td>
<td></td>
</tr>
<tr>
<td>Prin of Statistics</td>
<td>5</td>
</tr>
<tr>
<td>Stat 201</td>
<td></td>
</tr>
<tr>
<td>Urban Problems and Planning Goals</td>
<td>3</td>
</tr>
<tr>
<td>U P 361</td>
<td></td>
</tr>
<tr>
<td>Minor</td>
<td>3</td>
</tr>
<tr>
<td>Landscape Design</td>
<td>3</td>
</tr>
<tr>
<td>L A 312</td>
<td></td>
</tr>
<tr>
<td>Sociology of City Life</td>
<td>3</td>
</tr>
<tr>
<td>Soc 410</td>
<td></td>
</tr>
<tr>
<td>Intro to Computer</td>
<td>3</td>
</tr>
<tr>
<td>Organ &amp; Programming</td>
<td></td>
</tr>
<tr>
<td>C S 214</td>
<td></td>
</tr>
<tr>
<td>Planning Analysis &amp; Techniques</td>
<td>4</td>
</tr>
<tr>
<td>U P 372</td>
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<tr>
<td>Minor</td>
<td>3</td>
</tr>
<tr>
<td>Housing</td>
<td>3</td>
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<tr>
<td>Arch 363</td>
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</tr>
<tr>
<td>Econ of Urban Dev &amp; City Planning</td>
<td>3</td>
</tr>
<tr>
<td>Econ 461</td>
<td></td>
</tr>
<tr>
<td>Planning Analysis &amp; Techniques</td>
<td>3</td>
</tr>
<tr>
<td>U P 373</td>
<td></td>
</tr>
<tr>
<td>Theory of the Planning Process</td>
<td>3</td>
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<tr>
<td>U P 383</td>
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<tr>
<td>Fund of Speech</td>
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<tr>
<td>Sp 211</td>
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<td>Minor</td>
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</table>

### Senior Year

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
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<tbody>
<tr>
<td>Econ of Urban Dev &amp; City Planning</td>
<td>3</td>
</tr>
<tr>
<td>Econ 462</td>
<td></td>
</tr>
<tr>
<td>Travel &amp; Practice</td>
<td>R</td>
</tr>
<tr>
<td>L A 341 or 342</td>
<td></td>
</tr>
<tr>
<td>Human Ecology</td>
<td>3</td>
</tr>
<tr>
<td>Soc 450</td>
<td></td>
</tr>
<tr>
<td>Urban Dev Planning</td>
<td>3</td>
</tr>
<tr>
<td>U P 431</td>
<td></td>
</tr>
<tr>
<td>Planning Law &amp; Admin</td>
<td>3</td>
</tr>
<tr>
<td>U P 492</td>
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<td>Elective</td>
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<td>Minor</td>
<td>3</td>
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<tr>
<td>Engr in City Plan</td>
<td>3</td>
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<tr>
<td>C E 404</td>
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<td>Traffic Planning</td>
<td>4</td>
</tr>
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<td>C E 451</td>
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</tr>
<tr>
<td>Urban Dev Programming</td>
<td>3</td>
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<tr>
<td>U P 432</td>
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<td>Elective</td>
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<tr>
<td>Elective</td>
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</tr>
<tr>
<td>Minor</td>
<td>3</td>
</tr>
</tbody>
</table>

Electives to include 10 credits of biological science
Ag 104, six months of work experience, is required before graduation

### Curriculum in Resource Development for Outdoor Recreation

Administered by the College of Agriculture through the Office of the Associate Dean. Leading to the degree Bachelor of Science. Total credits required, 200, plus six 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.
### Basic Subjects

<table>
<thead>
<tr>
<th>I Communications</th>
<th>19</th>
</tr>
</thead>
<tbody>
<tr>
<td>English 101, 102, 103, Sp 211, 302, Tech JI 225, Library 116A</td>
<td></td>
</tr>
<tr>
<td>II Mathematics and Statistics</td>
<td>13</td>
</tr>
<tr>
<td>Math 101, 102, Stat 201A</td>
<td></td>
</tr>
<tr>
<td>III Physical Sciences</td>
<td>24</td>
</tr>
<tr>
<td>Chem 101, 102, 231, Physics 111, 112, Geol 100</td>
<td></td>
</tr>
<tr>
<td>IV Social Sciences and Humanities</td>
<td>30</td>
</tr>
<tr>
<td>Govt 215, 474, Econ 241, 242, 434, 451, Soc 134, 364, Hist 324, Psych 101</td>
<td></td>
</tr>
<tr>
<td>V Biological Sciences</td>
<td>32</td>
</tr>
<tr>
<td>Bot 210, 310, 424, Zool 101, 102, 274 or 376, Bact 200, Gen 301</td>
<td></td>
</tr>
</tbody>
</table>

### Professional and Technical Subjects

| VI Agronomy and Agricultural Engineering | 15 |
| Agron 114 or Hort 114, Agron 357, 473, Ag Engr 371 |  |
| VII Fisheries and Wildlife Biology | 16 |
| Zool 141, 340, 402, 464 |  |
| VIII Forestry | 13 |
| For 160, 301, 302 or 447, 400 |  |
| IX Horticulture | 12 |
| Hort 214, 305, 313, 314 |  |
| X Landscape Architecture | 16 |
| L A 113, 210, 231, 232, 253, 404 |  |

| Total Professional and Technical Subjects Credits | 72 |
| Total Basic Subjects Credits | 118 |
| Electives | 10 |

| Total Credits | 200 |


### 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, 200, plus six 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 *Teacher Education*

### College and Departmental Group Requirements

| I Written and Spoken English | 15 |
| including Engl 101, 102, 103, Sp 211 |  |
| II Mathematics, Statistics | 13 |
| including Math 101, 102 or equiv |  |
| III Physical Sciences | 16 |
| including Chem 101, 102, Phys 111 or 221 |  |
| IV Biological Sciences | 16 |
| including Bot 101 and 202, or 210, Zool 102, 274 |  |
V Agricultural Sciences
  Including Agron 154A, 206
VI Social Sciences
  Including Econ 241, 242, Govt 215
VII Humanities
  Including credits in history and literature

Total Credits 100

Departmental Major and Minor Requirements
I Plant Pathology major minimum 30
  Including Bot 306, 310B, 404, 407 or 416, Gen 301
  Bact 304
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.

Curriculum in Poultry Science

With options in Production, Science, Industry and International Service. Leading to the
degree Bachelor of Science. Total credits required, 206. Also see Technical Agriculture
for two-year program.

Production Option

For those students interested in poultry farming, poultry farm management, county
extension work, hatchery or feed service operations or positions with farm organizations.

Industry Option

For those students interested in business aspects of the poultry industry such as feed
and hatchery service, plant management, poultry equipment sales, poultry products man-
ufacture, government inspection service, sales, advertising, promotion and public relations.

Science Option

For those students interested in research and development positions with feed com-
panies, poultry breeders, egg and poultry products manufacture and firms supplying
materials and services to the poultry industry. This option will serve as a pre-graduate
program for those students who would like to become college teachers, research workers
or extension specialists.

International Service Option

For those students interested in international aspects of the poultry industry such
as overseas employment by technical agencies of the federal government, with development
programs of church groups or with foreign trade sections of businesses or industries.

General Requirements

1. Freshman Year:
   During this year the student should complete 9 credits in English (Group I) and at
   least 5 credits in mathematics (Group II) and at least 30 credits in two or more of
   the other groups.

2. Sophomore, Junior and Senior Years:
   a. Requirements—Completion of group and option requirements.
   b. Electives—Completion of courses which will strengthen the student's over-all program,
3. Students taking ROTC may apply credits toward elective requirements.

Group Requirements

As a prerequisite to graduation, to provide a broad education in the physical, biological, and social sciences and in the humanities, each student must complete, sometime during the four years, the number of credits in the areas specified in each of the eight groups, including those courses listed.

<table>
<thead>
<tr>
<th>Group</th>
<th>Courses</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Communication Skills, Engl 101, 102, 103, Sp 211, Lib 116</td>
<td>16</td>
</tr>
<tr>
<td>II</td>
<td>Mathematics and Statistics, Math 101, 102, Stat 201A</td>
<td>13</td>
</tr>
<tr>
<td>III</td>
<td>Physical Sciences, Chem 101, 102, Phys 111, Biochem</td>
<td>16</td>
</tr>
<tr>
<td>IV</td>
<td>Biological Sciences, Zoal 101, 102, 224, 234, Gen 301, Bact 304</td>
<td>30</td>
</tr>
<tr>
<td>V</td>
<td>Social Sciences and Humanities, Govt 215, 3 credits economics, sociology, government, psychology, 9 credits art, history, literature, music, philosophy, 6 credits</td>
<td>18</td>
</tr>
<tr>
<td>VI</td>
<td>Poultry Science, Po Sci 101, 110, 301, 302, 305, 401, 402, 403, and 404</td>
<td>28</td>
</tr>
<tr>
<td>VIII</td>
<td>Other, P.E. 6 credits</td>
<td>6</td>
</tr>
</tbody>
</table>

Option Requirements

Industry

1. Required courses
   - Chem 231, Econ 313, 335, 403, Psych 250 | 17 |
2. Electives | 46 |

Production

1. Required courses
   - Chem 231, Psych 250 | 8 |
2. Electives | 55 |

Science

1. Required courses
   - Chem 103, 211, 334, 335, Phys 112, Math 110, 111 | 29 |
2. Electives | 34 |

International Service

See Index, International Service Programs

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 Cooperative Extension Service central staff. In 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.

### 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 Master of Science or Doctor of Philosophy degree in Agriculture. Graduate students usually are required to have a reading knowledge of French, Spanish, Russian or German before the Master’s degree can be conferred; they must have a reading knowledge of two languages before the Doctor’s degree can be conferred.

### Table of Recommended Courses

**Sophomore Year**

<table>
<thead>
<tr>
<th>Quarter</th>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>FALL QUARTER</td>
<td>General Psychology I</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Psych 101</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Survey of Extension Education</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Ag Ed 211 B</td>
<td></td>
</tr>
<tr>
<td>WINTER QUARTER</td>
<td>Methods of Teaching</td>
<td>3-4</td>
</tr>
<tr>
<td></td>
<td>Rural Institutions</td>
<td></td>
</tr>
<tr>
<td></td>
<td>and Organizations</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Soc 200</td>
<td>4</td>
</tr>
<tr>
<td>SPRING QUARTER</td>
<td>Prin of Horticulture</td>
<td>3-4</td>
</tr>
<tr>
<td></td>
<td>Hort 114A</td>
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</tr>
</tbody>
</table>

**Junior Year**

<table>
<thead>
<tr>
<th>Quarter</th>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>FALL QUARTER</td>
<td>Adm and Org of Ext Ed</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Ed 466</td>
<td></td>
</tr>
<tr>
<td>WINTER QUARTER</td>
<td>Group Dynamics</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Soc 364</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Publicity and Public Relations</td>
<td></td>
</tr>
<tr>
<td></td>
<td>T JI 225</td>
<td>3</td>
</tr>
<tr>
<td>SPRING QUARTER</td>
<td>Methods of Ext Ed.</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Ed 467</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2 Farm Mgt and Org.</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Econ 330</td>
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**Senior Year**

<table>
<thead>
<tr>
<th>Quarter</th>
<th>Course</th>
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</thead>
<tbody>
<tr>
<td>FALL QUARTER</td>
<td>Hort Entomology</td>
<td>3-4</td>
</tr>
<tr>
<td></td>
<td>Zool 375</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Mgt of Ten -Op Farms</td>
<td>2</td>
</tr>
<tr>
<td>WINTER QUARTER</td>
<td>Community Action</td>
<td>3-4</td>
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<tr>
<td></td>
<td>Soc 464</td>
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<tr>
<td>SPRING QUARTER</td>
<td>Prin. of Plant Pathology</td>
<td>3</td>
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<tr>
<td></td>
<td>Bot 407</td>
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<tr>
<td></td>
<td>Business Correspondence</td>
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<tr>
<td></td>
<td>Engl. 404</td>
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</tbody>
</table>

Juniors and seniors may gain experience by working as assistants to Extension staff members during the summer months.

Other desirable courses are Psych 230, 333, Ed 537, 550; Soc 387, 486, T. JI 475, Econ 447; Sp 312, Ag 450, and C D 270.

1 Soc 134, if required in the student's curriculum, will meet this need.
2 Econ 130, if required in the student's curriculum, will meet this need.
3 Zool 374 will also meet this need.

### Table of Recommended Courses for Graduate Study

**Sophomore Year**

<table>
<thead>
<tr>
<th>Quarter</th>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>FALL QUARTER</td>
<td>Algebra and Trig I</td>
<td>5</td>
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<tr>
<td></td>
<td>Math 101</td>
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</tr>
<tr>
<td></td>
<td>Systematic Inorganic Chemistry</td>
<td>4</td>
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<tr>
<td></td>
<td>Chem 103</td>
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<tr>
<td>WINTER QUARTER</td>
<td>Algebra and Trig II</td>
<td>5</td>
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<tr>
<td></td>
<td>Math 102</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Organic Chemistry</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Chem 334</td>
<td></td>
</tr>
<tr>
<td>SPRING QUARTER</td>
<td>Analytic Geometry and Calculus I</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Math 110</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Organic Chemistry</td>
<td>4</td>
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<td></td>
<td>Chem 335</td>
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**Junior Year**

<table>
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<td>FALL QUARTER</td>
<td>Quantitative Analysis</td>
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<td></td>
<td>Phys 111</td>
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<td>WINTER QUARTER</td>
<td>Quantitative Analysis</td>
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<td></td>
<td>Chem 212</td>
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<tr>
<td>SPRING QUARTER</td>
<td>Writing of Scientific Papers</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Engl. 414</td>
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</tr>
<tr>
<td></td>
<td>General Physics</td>
<td>4</td>
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<tr>
<td></td>
<td>Phys 113</td>
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### FALL QUARTER

<table>
<thead>
<tr>
<th>Subject</th>
<th>Credits</th>
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<tbody>
<tr>
<td>Reading Knowledge of Sci French or German</td>
<td>4</td>
</tr>
<tr>
<td>F L 101A or 131A</td>
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</table>

### WINTER QUARTER

<table>
<thead>
<tr>
<th>Subject</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>Principles of Statistics</td>
<td>4</td>
</tr>
<tr>
<td>Stat 201</td>
<td></td>
</tr>
<tr>
<td>Reading Knowledge of Sci German</td>
<td>3</td>
</tr>
<tr>
<td>F L 132A</td>
<td></td>
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</tbody>
</table>

### SPRING QUARTER

<table>
<thead>
<tr>
<th>Subject</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reading Knowledge of Sci German</td>
<td>4</td>
</tr>
<tr>
<td>F L 133A</td>
<td></td>
</tr>
</tbody>
</table>

#### Training for International Service

Agricultural students desiring to work in foreign countries with private industry, governmental agencies, or private foundations and institutions are referred to the section headed *International Service Programs* for suggested courses they might take as electives or substitute for required courses.
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 for civilian or military use; 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 involve 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 the engineering sciences and their application to engineering is offered in the postgraduate programs. For details of graduate study in engineering, see the Graduate College section of this Catalog.

The College of Engineering also administers the two-year programs of the Technical Institute in which students are prepared for careers as engineering technicians. For details of the programs of the Technical Institute and of the requirements for admission to the Technical Institute, see index of this Catalog.
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 (five 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 complete the program. 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.

Advising System

The purpose of the advising system in the College of Engineering is to maintain close contact with the student 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.
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.

Curricula in College of Engineering

<table>
<thead>
<tr>
<th>Curricula in College of Engineering</th>
<th>Professional Engineering Curricula</th>
<th>Graduate Programs</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Aerospace Engineering</td>
<td>4 yr reg &amp; 5 yr Co-op, B S</td>
<td>M. Eng., M. S.,</td>
</tr>
<tr>
<td>1 Agricultural Engineering</td>
<td>4 yr reg &amp; 5 yr Co-op, B S</td>
<td>Ph. D. (joint major)</td>
</tr>
<tr>
<td>1 Biomedical Engineering</td>
<td>4 yr reg &amp; 5 yr Co-op, B S</td>
<td>M. Eng., M. S., Ph.D</td>
</tr>
<tr>
<td>1 Ceramic Engineering</td>
<td>4 yr reg &amp; 5 yr Co-op, B S</td>
<td>M. S., Ph.D</td>
</tr>
<tr>
<td>1 Chemical Engineering</td>
<td>4 yr reg &amp; 5 yr Co-op, B S</td>
<td>M. Eng., M. S., Ph.D</td>
</tr>
<tr>
<td>1 Civil Engineering</td>
<td>4 yr reg &amp; 5 yr Co-op, B S</td>
<td>M. Eng., M. S., Ph.D</td>
</tr>
<tr>
<td>1 Electrical Engineering</td>
<td>4 yr reg &amp; 5 yr Co-op, B S</td>
<td>M. S., Ph.D</td>
</tr>
<tr>
<td>1 Engineering Mechanics</td>
<td>(Graduate only)</td>
<td></td>
</tr>
<tr>
<td>1 Engineering Science</td>
<td>4 yr B S</td>
<td></td>
</tr>
<tr>
<td>1 Industrial Engineering</td>
<td>4 yr reg &amp; 5 yr Co-op, B S</td>
<td></td>
</tr>
<tr>
<td>1 Mechanical Engineering</td>
<td>4 yr reg &amp; 5 yr Co-op, B S</td>
<td></td>
</tr>
<tr>
<td>2 Metallurgy</td>
<td>4 yr B S</td>
<td></td>
</tr>
<tr>
<td>Nuclear Engineering</td>
<td>(Graduate only)</td>
<td></td>
</tr>
<tr>
<td>3 Architecture</td>
<td>5 yr, B. Arch.</td>
<td>M. Arch.</td>
</tr>
<tr>
<td>Building Construction</td>
<td>4 yr reg &amp; 5 yr Co-op, B S</td>
<td>(undergraduates only)</td>
</tr>
<tr>
<td>Engineering Operations</td>
<td>4 yr reg &amp; 5 yr Co-op, B S</td>
<td>(undergraduates only)</td>
</tr>
<tr>
<td>Related Curricula</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 Chemical Industries Technology</td>
<td>6 qtr., Assoc. in App. Sci</td>
<td></td>
</tr>
<tr>
<td>4 Construction Technology</td>
<td>61/2 qtr. reg. &amp; 10 qtr Co-op, App. Sci</td>
<td></td>
</tr>
<tr>
<td>4 Electronics Technology</td>
<td>6 qtr., Assoc. in App. Sci</td>
<td></td>
</tr>
<tr>
<td>4 Mechanical Technology</td>
<td>6 qtr. reg. &amp; 8 qtr Co-op, App. Sci</td>
<td></td>
</tr>
</tbody>
</table>

1 Accredited by the Engineers' Council for Professional Development (ECPD)
2 New Program: Will apply for accreditation at next inspection.
3 Accredited by the National Architectural Accreditation Board.
4 An ECPD accredited Engineering Technology Curriculum
Physical Education and Reserve Officers Training Corps (ROTC)

In addition to the requirements listed in the various engineering curricula, all students are required to take six quarters of physical education. See Physical Education for Men for details. A student is expected to enroll in Physical Education during his first quarter in school and to continue enrolling in it each subsequent quarter until the requirement is completed. Credits received in the required physical education courses may not be used as electives in any of the engineering curricula.

At the discretion of each department up to 6 credits of Basic ROTC and up to 6 credits of Advanced ROTC may be applied toward graduation requirements.

Basic Program for Professional Engineering Curricula

SELECTION OF CURRICULUM BY THE STUDENT. The basic (first year) programs for all professional curricula of the College of Engineering are similar, and thus a student may transfer from one department to another within the College without undue loss of time. There are some differences; hence, the student who desires to complete his work in minimum time will find it desirable to select his major department as soon as possible. The basic program includes the following list of courses shared in common and requirements for the individual curriculum. Students who are not adequately prepared may have to take one or more of the following courses: Math. 101, 102, and Chem. 101 (None of these courses may be used to satisfy elective requirements of the various engineering curricula). Students who begin with Math. 101 will take I.E. 104 and 105 in place of I.E. 108.

Common to all Professional Engineering Curricula

<table>
<thead>
<tr>
<th>FALL QUARTER</th>
<th>WINTER QUARTER</th>
<th>SPRING QUARTER</th>
</tr>
</thead>
<tbody>
<tr>
<td>Credits</td>
<td>Credits</td>
<td>Credits</td>
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<tr>
<td>Prin. of Composition Eng 101</td>
<td>Prin. of Composition Eng 102</td>
<td>Prin. of Composition Eng 103</td>
</tr>
<tr>
<td>Drawing and Projection E Gr 131</td>
<td>Graphical Theory and Application, E Gr 132</td>
<td>Departmental Technical Lecture, Engr 100</td>
</tr>
<tr>
<td>Methods of Engr. Computation I E 108</td>
<td>Library Instruction Lib 106</td>
<td>Orientation, Engr 115</td>
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<tr>
<td>Orientation, Engr 114 R</td>
<td></td>
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</tbody>
</table>

Additional Department Curriculum Requirements

Aero. E ...  Chem. 102A Fall, Chem. 103 Winter, Phys. 221 and Socio-Humanistic Elective (Cr. 3) Spring
A E  Chem. 102A Fall, Chem. 231 (Cr 4) and I E 109 Winter, Phys 221, E Gr 133, and Elective (Cr 3) Spring
Cer E  Chem. 102A Fall, Chem. 103 Winter, Phys. 221, E Gr 133 and Elective (Cr 3) Spring
Ch E  Chem. 102A Fall, Chem. 103 and I.E. 109 Winter, Electives (Cr 3) Spring
C.E  Chem. 102A Fall, Phys. 211 and I.E. 109 Winter, Phys. 223 and E Gr. 133 Spring
E.E  Phys. 221 Fall, Phys. 222 Winter, Phys. 223 and Econ 241 Spring
E Sci  Phys. 221 Fall, Phys. 222 Winter, Phys. 223 and E Gr. 133 Spring
I.E  Chem. 102A Fall, Chem. 103 and I.E. 109 Winter, Phys. 221 and E. Gr. 133 Spring
M.E  Chem. 102A Fall, Phys. 221 Winter, Phys. 223, E Gr. 133 and I.E. 109 Spring
Met.  Chem. 102A Fall, Chem 103 Winter, Phys. 221 and Elective (Cr 3) Spring

In addition to the courses listed above, each student will be required to include six credits of physical education.
Based upon the student's preparation and progress his adviser may require or recommend courses in addition to those specified above. Students must essentially 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.

**Curriculum in Aerospace Engineering**

Leading to the degree Bachelor of Science. Total credits required, 208. See also *Basic Program*.

<table>
<thead>
<tr>
<th>Fall Quarter</th>
<th>Winter Quarter</th>
<th>Spring Quarter</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sophomore Year</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aerodynamics I</td>
<td>Aerodynamics II</td>
<td>Performance of Aerospace Vehicles</td>
</tr>
<tr>
<td>Aero E 244</td>
<td>Aero E 245</td>
<td>Aero E 342</td>
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<tr>
<td>Analytical Geometry and Calculus IV</td>
<td>Introduction to Applied Mathematics</td>
<td>Introduction to Applied Mathematics</td>
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<td>Math 213</td>
<td>Math 321</td>
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<td>Aerospace Laboratory</td>
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<td>Aero E 271</td>
<td>Aero E 272</td>
<td>Aero E 273</td>
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<tr>
<td>Statics of Engr</td>
<td>Dynamics of Engr</td>
<td>General Physics</td>
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<tr>
<td>E M 274</td>
<td>E M 344</td>
<td>Phys 223</td>
</tr>
<tr>
<td>Intro to Computer Organization and Programming</td>
<td>Introductory Metallurgy</td>
<td>Mechanics of Materials</td>
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<tr>
<td>C S 214</td>
<td>Met 202</td>
<td>E M 324</td>
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<tr>
<td>Fundamentals of Speech</td>
<td>Socio-Humanistic Elective</td>
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<td>2 Socio-Humanistic Elective</td>
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**Colleges and Curricula**

**FALL QUARTER**  
176  
**Credits**  
Aerodynamic Theory I  
Aero. E. 441  
3  
Fundamentals of Automatic Controls for Flight Vehicles  
Aero. E. 431  
3  
Mechanical Vibration  
E M 444  
4  
Aerospace Seminar  
Aero. E. 491  
R  

**WINTER QUARTER**  
**Credits**  
Aerospace Seminar  
Aero. E 492  
R  

**SPRING QUARTER**  
**Credits**  

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1 Technical electives are to be taken as sequences. At least two (2) sequences must be taken from (Group I):  
- Group II: Electrical Engineering, Mathematics (including 404, 407, and 408), Mechanical Engineering (including M E 325), Metallurgy, Nuclear Engineering, Junior or Senior Phys., Statistics (including Stat. 215 must be among the courses selected)  

2 These courses are to be chosen from the Department-approved list of Socio-Humanistic sequences. Govt. 215 must be among the courses selected.  

3 Students selecting the design sequence will take an additional technical elective.

---

**Curriculum in Agricultural Engineering**

With options in Electric Power and Processing, Farm Power and Machinery, Farm Structures, and Soil and Water Control.

Administered jointly by the College of Agriculture and the College of Engineering. Leading to the degree Bachelor of Science. Credits required for graduation, 208. Six months of practical work in agriculture or industry acceptable to this department is required before graduation.

See also Basic Program and Cooperative Programs

**FALL QUARTER**  
**Credits**  
Agricultural Machines  
A E 236  
3  
Fund. of Soil Science  
Agron 154  
4  
Analytic Geometry and Calculus IV  
Math 213  
3  
General Physics  
Phys 222  
5  
Principles of Statistics  
Stat 201B  
3  
Agr. Applications of Electrical Energy  
A E 362  
3  
A-C and D-C Circuits  
A E 441  
4  
Dynamics of Engr  
E M 344  
4  
1 Socio-Humanistic Electives  
Seminar  
3  
A E 301  
R  
2 Option or Electives  
3  
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18  

**WINTER QUARTER**  
**Credits**  
Engineering Problems in Livestock Prod  
A E 217  
4  
Introduction to Applied Mathematics  
Math 321  
3  
General Physics  
Phys 223  
5  
Statics of Engineering  
E M 274  
4  
Electives  
3  
---  
19  

**SPRING QUARTER**  
**Credits**  
Fund of Soil and Water Control Engr  
A E 224  
5  
Materials and Processes  
A E 259  
3  
Mech of Materials  
E M 324  
5  
Materials Laboratory  
E M 327  
1  
Fundamentals of Botany  
Bot 410  
5  
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19  

**Sophomore Year**  
**Credits**  
A-C and D-C Circuits  
E. E 442  
4  
Thermodynamics I  
M E 321  
4  
Mechanics of Fluids  
E M 378  
4  
Socio-Humanistic Electives  
Seminar  
3  
A E 302  
R  
2 Option or Electives  
3  
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17  

**Junior Year**  
**Credits**  
Agr. Tractor Power  
A E 346  
4  
Electronic Circuits Instruments and Systems  
E E. 445  
4  
Principles of Economics  
Econ 241  
3  
1 Socio-Humanistic Electives  
Seminar  
3  
A E 303  
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2 Option or Electives  
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<td>Environmental Control in Agr. Structures A. E. 488</td>
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1. Socio-humanistic sequences are to be chosen from the department-approved list.
2. In the junior and senior years the student will elect one of the options and take the courses listed in the selected option. Electives must be approved in advance by the department head.

**Options**

<table>
<thead>
<tr>
<th>Electric Power and Processing</th>
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<th>Soil and Water Control</th>
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<td>Mechanical Behavior of Metals Mechanical Behav 1or of Metals M E 235</td>
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**Curriculum in Architecture**

A basic concentration leading to the degree of Bachelor of Architecture with alternate concentrations in construction, delineation planning and structures. Credits required for graduation 264. Twenty weeks of practical experience with approved architectural or construction firms are required.
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1. Choose from department-approved electives. A minimum of 18 credits should be selected from social studies and humanities. A maximum of 12 credits may be selected from the physical or biological sciences.

2. Sequence of courses determined by the selection of one of the following concentrations:

#### Basic Concentration

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<th>FWS Arch 331-3 cr., 332-3 cr., 333-3 cr.</th>
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<tr>
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<td>FWS Urban Planning 361-3 cr., 372-3 cr., 373-3 cr</td>
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*Selected from courses listed under other concentrations.

### Planning Concentration

Students may select a minimum of 27 credits from the following list: Soc 134, 201, 218, 301, 364, 410, 445, 450, 464; Econ 241, 242, 243, 305, 310, 311, 471, 510; CE 350, 451, UP 253, 361, 372, 373, 383, 431, 432, 433, 492.

### Structures Concentration

Students may select a minimum of 27 credits from the following list: Math. 213, 321, 322; EM 514; Geol. 301; CE 360, 361, 460, 448, 449, 532, 533, 534, 538, 539, 540, 544, 545, 546, 547.

Students must have a 2.50 cumulative grade point average or permission of the Civil Engineering department head to be eligible for 500 level courses in Civil Engineering.

### Delineation Concentration

Students may select a minimum of 27 credits from the following list: Arch. 233, 331, 332, 333, 430, 460, 531, 532, 533, AA 233, 306, 324, 406, 424, 434, 464, 465, 486, 490.

### Construction Concentration

Students may select a minimum of 27 credits from the following list: Econ 241, 242, 243, 305, 441, 445; Arch. 346, 355, 371, 372, 373, 441, 442, 480; I. Ad 371.

Additional concentrations in fields relative to Architecture may be arranged with the approval of the head of the department.
Curriculum in Building Construction

Administered by the Department of Architecture.
Leading to the degree Bachelor of Science in Building Construction.
Credits required for graduation 190.

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1 or IE 480
2 These electives are to be selected from the department-approved list of socio-humanistic sequences
## Colleagues and Curricula

### FALL QUARTER Credits
- Construction Progress Scheduling II Arch 441 3
- Electrical Applications in Buildings Arch 481 4
- Bus. or Mgt Elective 3
- Reinforced Conc. Dgn CE 43A 4
- Soc-Human Elect 3

### WINTER QUARTER Credits
- Construction Progress Scheduling III Arch 442 3
- Heating, Ventilation and Air Conditioning ME 406 4
- Technical Elect 3
- Elective 3
- Soc-Human Elect 3

### SPRING QUARTER Credits
- Spec Problems in Build Const. Arch 480 3
- Writing of Reports and Technical Papers Engl 41A 3
- Technical Elect 3
- Bus. or Mgt Elective 3
- Soc-Human Elect 3

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2 These electives are to be selected 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, 208.

See also Basic Program.

### FALL QUARTER Credits
- Ceramic Raw Materials Cer E 213 4
- Analytic Geometry and Calculus IV Math 213 3
- General Physics Phys 222 5
- Socio-Humanistic Elective 3
- Seminar Cer E 201 R

### WINTER QUARTER Credits
- Ceramic Engr Operations I Cer E 214 4
- Quantitative Analysis Chem 211 4
- Statics of Engineering E M 274 4
- General Physics Phys 223 5
- Seminar Cer E 202 R

### SPRING QUARTER Credits
- Ceramic Calc and Pyrometry Cer E 215 5
- Quantitative Analysis Chem 212 4
- Introduction to Applied Mathematics Math 323 3
- Elective 3
- Socio-Humanistic Elective 3
- Seminar Cer E 203 R

In addition to the courses listed above, each student will be required to include in his schedule P E M

### Junior Year

| Ceramic Colloid and Phase Equilibria Cer E 311 4 |
| A-c and D-c Circuits E E 441 4 | Vitreous State Cer E 312 4 |
| Principles of Economics Econ 241 3 | Mechanics of Materials E M. 324 5 |
| Mineralogy Geol 355 4 | Principles of Economics Econ 242 3 |
| Physical Chemistry Chem 321 3 | Physical Chemistry Chem 322 3 |
| Seminar Cer E 301 R | Socio-Humanistic Elective 3 |

### Senior Year

| Ceramic Engr Operations II Cer E 323 4 |
| Dynamics of Engineering E M. 344 4 | Materials Laboratory E M. 327 1 |
| Heat Transfer M. E 325 3 | Physical Chemistry Chem 323 3 |
| Socio-Humanistic Elective 3 | Inspection Trip Cer E 400 R |
| Seminar Cer E 303 R |
### FALL QUARTER

| Credits | Ceramic Industries I  
| Cer E 415 |
|---------|----------------------|
| 3       | Ceramic Development and Control  
| Cer E 430 |
| 4       | Mechanics of Fluids  
| E, M 378 |
| 4       | 1 Socio-Humanistic Electives  
| Cer E 401 |
| R       | 1 Socio-Humanistic Electives  
| Cer E 402 |
| R       | Total: 17 |

### WINTER QUARTER

| Credits | Ceramic Industries II  
| Cer E 416 |
|---------|----------------------|
| 3       | Ceramic Engr Design  
| Cer E 427 |
| 5       | Electronic Ceramics  
| Cer E 441 |
| 3       | Optical Mineralogy  
| Geol 454 |
| 4       | Electronic Circuits, Instruments and Systems  
| E E 445 |
| 4       | 1 Socio-Humanistic Electives  
| Cer E 403 |
| R       | Total: 19 |

### SPRING QUARTER

| Credits | Ceramic Industries III  
| Cer E 417 |
|---------|----------------------|
| 3       | Ceramic Engr Design  
| Cer E 428 |
| 4       | Ceramic Development and Control  
| Cer E 435 |
| 3       | Writing of Scientific Papers  
| Engl 414 |
| 3       | 1 Socio-Humanistic Electives  
| Cer E 403 |
| R       | Total: 19 |

---

1. These electives are to be chosen from the department-approved list of socio-humanistic sequences. Govt 215 must be among the courses elected, six credits of advanced ROTC may be substituted for three credits of socio-humanistic electives and Engl 414.

2. Students taking basic ROTC may substitute credit in 100 and 200 courses for these electives.
Curriculum in Chemical Engineering

Leading to the degree Bachelor of Science with options in Design and Production and in Research and Development.

Total credits required, 206 in Design and Production; 204 in Research and Development option.

See also Basic Program

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| **Chem E Unit Operations** | **Chem E Unit Operations** | **Junior Inspection Trip** |
| Chem E 361 | Chem E 362 | Chem E 300 | R |
| 3 | 3 |
| **Laboratory in Physical Chemistry** | **Laboratory in Physical Chemistry** | **Laboratory in Physical Chemistry** |
| Chem 320A | Chem 320B | Chem 320C | 1 |
| 1 | 2 | 3 |
| **Physical Chemistry** | **Physical Chemistry** | **Physical Chemistry** |
| Chem 321 | Chem 322 | Chem 323 | 1 |
| 3 | 3 | 3 |
| **Organic Chemistry** | **Organic Chemistry** | **Organic Chemistry** |
| Chem 334 | Chem 335 | Chem 336 | 3 |
| 4 | 4 | 3 |
| **Mechanics of Materials** | **D-c and A-c Circuits and Machines** | **D-c and A-c Circuits and Machines** |
| E M 324 | E E 341 | E E 342 | 4 |
| 5 | 4 | 4 |
| 1 | **Socio-Humanistic Elective** | **Socio-Humanistic Elective** |
| 3 | 3 |

| 19 | 19 | 19 |

| **Technical Seminar** | **Technical Seminar** | **Technical Seminar** |
| Chem E 401 | Chem E 402 | Chem E 403 | R |
| R | | |
| **Process Control** | **Chem Process Industries** | **Chem E Laboratory** |
| Chem E 435 | Chem E 411 | Chem E 422 | 2 |
| 4 | 3 |
| **Transport Phenomena** | **Chem E Laboratory** | **Chemical Reactor Design** |
| Chem E 431 | Chem E 421 | Chem E 463 | 3 |
| 3 | 2 |
| **Rate Processes Laboratory** | **Chem E Thermodynamics** | **Chem E Design** |
| Chem E 450 | Chem E 462 | Chem E 473 | 3 |
| 2 | 2 |
| **Chem E Thermodynamics** | **Chem E Design** | **Chem E Design** |
| Chem E 461 | Chem E 472 | Chem E 473 | 3 |
| 3 | 3 |
| **Chem E Design** | **Socio-Humanistic Elective** | **Socio-Humanistic Elective** |
| Chem E 471 | 3 | 6 |
| 3 | | |
| 18 | 16 | 17 |

| **1 Socio-Humanistic Elective** | **Elective** | **Elective** |
| 3 | 3 | 3 |
# College of Engineering

### FALL QUARTER

<table>
<thead>
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<tbody>
<tr>
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### WINTER QUARTER

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<td>Econ. 242</td>
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<td>Intermediate Mechanics</td>
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### Senior Year

<table>
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<tbody>
<tr>
<td>Technical Seminar</td>
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<td>Chem. E 401</td>
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<td>Process Control</td>
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<td>Chem. E 435</td>
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<td>Chem. E. 431</td>
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<td>Rate Processes Laboratory</td>
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<td>Chem. E. 450</td>
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<td>Chem. E. Thermodynamics</td>
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<td>Chem. E. 461</td>
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### Research and Development Option

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<td>Transport Phenomena</td>
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<td>Chem. Process Industries</td>
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<td>Chem. E. 462</td>
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<tr>
<td>A-C and D-C Circuits</td>
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1. These electives are to be chosen from the department-approved list of socio-humanistic electives. Govt 215 must be among the courses elected.
2. E. M. 274 and either E. M. 324 or 344 may be substituted for Phys. 354, 355.
3. Advanced ROTC credit may be substituted for this.
Curriculum in Civil Engineering

Leading to degree, Bachelor of Science - Total credits required, 200.
See also Basic Program.

<table>
<thead>
<tr>
<th>FALL QUARTER</th>
<th>WINTER QUARTER</th>
<th>SPRING QUARTER</th>
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<tbody>
<tr>
<td>Credits</td>
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<td>Credits</td>
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<td>Chem 103</td>
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<td>Photogrammetry, Mapping and Land Surveying</td>
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<td>Sanitary Engineering II</td>
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<td>C E 426</td>
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<td>Engl 414A</td>
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<td>Designing Transportation Facilities</td>
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</table>

1 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 & momentum transfer, electrical theory, materials, similitude, 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, 204.
See also Basic Program

<table>
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<th>SPRING QUARTER</th>
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<td><strong>Credits</strong></td>
<td><strong>Credits</strong></td>
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<td><strong>Sophomore Year</strong></td>
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<tr>
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<td>Electric Circuit Theory</td>
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<td>Intro to Appl Math I</td>
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</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 third and fourth years may omit six credits from this elective group.
3 Students electing to take basic ROTC may apply ROTC credits toward this elective requirement. For others this is an unrestricted elective except that Math 101, 102, Chem 101, and E E 104, 105, may not be used to satisfy this requirement.
4 All students must take at least 22 credits from the Electrical Engineering technical electives listed below. 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.
ELECTRICAL ENGINEERING TECHNICAL ELECTIVES

<table>
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<tr>
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<th>Credits</th>
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<tr>
<td>Introduction to Switching Circuits 410</td>
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<tr>
<td>Introduction to Systems Analysis 417</td>
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<tr>
<td>Lines, Waves and Radiation 421</td>
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<tr>
<td>Power System Engineering 465</td>
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</tr>
<tr>
<td>Recurrent Transient and Digital Circuits 426</td>
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<td>Electric Power Machinery 452</td>
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<tr>
<td>Principles of Computer Design 411</td>
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</tr>
<tr>
<td>Introduction to Systems Analysis 418</td>
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<tr>
<td>Lines, Waves and Radiation 422</td>
<td>4</td>
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<tr>
<td>Power System Engineering 466</td>
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<td>Electrical Energy Sources 431</td>
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<td>Principles of Computer Design 412</td>
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<td>Communication Systems Anal &amp; Design 527</td>
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<tr>
<td>Lines, Waves &amp; Radiation 423</td>
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<tr>
<td>Power System Engineering 467</td>
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<tr>
<td>Electrical Properties of Materials 428</td>
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<td>Control System Synthesis 575</td>
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Curriculum in Engineering Operations

Administered by the Department of Industrial Engineering. Leading to the degree Bachelor of Science. Total credits required, 180.

This program 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.

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 Technical Journalism. See Engineering Journalism under Courses and Programs for details.

Program in International Service

Special training for those interested in foreign service is provided. See International Service under Courses and Programs for details.

Program in Engineering for Officer Education

Options are available for those students who desire to obtain a commission in the following branches of military service: Army, Navy, or Air Force. For details, see Officer Education programs in Courses and Programs.

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).

Required Courses

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<th>Basic Sciences</th>
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<tr>
<td>Chem 101, 102</td>
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<tr>
<td>Phys 221, 222, 223</td>
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<td>Socio-Humanistics:</td>
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<td>Psych 101</td>
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<td>Econ 241, 242</td>
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<td>Govt 215</td>
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<td>E Gr 131, 132, 133</td>
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<td>Engl 101, 102, 103</td>
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<td>Sp 211, Engl 414A</td>
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<td>I E 104, 105</td>
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<td>I E 480 or I Ad 365A</td>
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<td>I E 293, 393</td>
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180 Colleges and Curricula
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.

Credits

<table>
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<tr>
<th>Engineering Science (Minimums)</th>
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<tbody>
<tr>
<td>Engineering Mechanics 9, Electrical Engineering 8, Measurements 3</td>
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<tr>
<td>Sequences in an Engineering area (300 level or above)</td>
</tr>
<tr>
<td>Supporting Work (Basic and Engineering Sciences)</td>
</tr>
<tr>
<td>Management, Production, Business or Sales courses (300 level or above in I, Ad, or I E)</td>
</tr>
<tr>
<td>Socio-Humanistic Sequences</td>
</tr>
<tr>
<td>Elective</td>
</tr>
<tr>
<td>Total Program (minimum)</td>
</tr>
</tbody>
</table>

Curriculum in Engineering Science

Administered by the Department of Nuclear Engineering. Leading to the degree Bachelor of Science. Total credits required, 204. See also Basic Program.

### FALL QUARTER

<table>
<thead>
<tr>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anal Geom. and Calc IV Math 213</td>
</tr>
<tr>
<td>Statics of Engineering E M 274</td>
</tr>
<tr>
<td>General Chemistry Chem 205</td>
</tr>
<tr>
<td>Modern Physics Phys 301</td>
</tr>
<tr>
<td>Foreign Language</td>
</tr>
<tr>
<td><strong>Total</strong></td>
</tr>
</tbody>
</table>

### WINTER QUARTER

<table>
<thead>
<tr>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introd to Applied Math Math 321</td>
</tr>
<tr>
<td>Dynamics of Engineering E M 344</td>
</tr>
<tr>
<td>General Chemistry Chem 206</td>
</tr>
<tr>
<td>Modern Physics Phys 302</td>
</tr>
<tr>
<td>Foreign Language</td>
</tr>
<tr>
<td><strong>Total</strong></td>
</tr>
</tbody>
</table>

### SPRING QUARTER

<table>
<thead>
<tr>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introd to Applied Math Math 322</td>
</tr>
<tr>
<td>Mechanics of Materials E M 324</td>
</tr>
<tr>
<td>Modern Physics Phys 303</td>
</tr>
<tr>
<td>American Government Govt 215</td>
</tr>
<tr>
<td>Foreign Language</td>
</tr>
<tr>
<td><strong>Total</strong></td>
</tr>
</tbody>
</table>

### Sophomore Year

| Introd to Applied Math Math 410 | 3 |
| Chem E. Thermodynamics Chem E 461 | 3 |
| A-c and D-c Circuits E. E. 441 | 4 |
| Physical Chemistry Chem 321 | 3 |
| Socio-Humanistic Elective | 3 |
| E S 499 | 2 |
| **Total** | 18 |

### Junior Year

| Engineering Materials E S 351 | 4 |
| Mechanics of Fluids E M 378 | 4 |
| A-c and D-c Circuits E E 442 | 4 |
| Physical Chemistry Chem 322 | 3 |
| Socio-Humanistic Elective | 3 |
| **Total** | 18 |

### Senior Year

| Engineering Analysis E S 481 | 4 |
| Engineering Materials E S 353 | 4 |
| Elective | 3 |
| **Total** | 17 |
FALL QUARTER | WINTER QUARTER | SPRING QUARTER
--- | --- | ---
**Credits** | **Credits** | **Credits**
1 Socio-Humanistic Elective | 1 Socio-Humanistic Elective | 1 Socio-Humanistic Elective

In addition to the courses listed above, each student will be required to include Seminar, E S. 401, 402, 403 in his schedule.

1 These electives are to be chosen from the department-approved list of socio-humanistic sequences.
2 Engineering Science electives include courses in mechanics of solids, mechanics of fluids, nature and properties of materials, electrical theory, thermodynamics and transport phenomena.
3 May be omitted by students appointed in advanced ROTC.

Curriculum in Industrial Engineering

Leading to the degree Bachelor of Science. Total credits required, 195. See also Cooperative Programs and Basic Program.

FALL QUARTER | WINTER QUARTER | SPRING QUARTER
--- | --- | ---
**Credits** | **Credits** | **Credits**
Anal Geom & Calc IV | Disc & Cont Math Mod Math 304 | Disc & Cont Math Mod Math 305
Math 213 | General Physics Phys 223 | Mechanics of Materials E M 324
Intro to Ind Engr I E 250 | Engr Metallurgy M E 211 | Principles of Economics Econ. 242
General Psychology Psych 101 | | R

18 | 18 | 15

Junior Year

Quantitative Methods
for Ind. Engr I. E. 361 | Intro to Management Science I. E. 312 | Engr Economy I. E. 404
A-c and D-c Circuits E E 441 | Industrial Accounting I Ad 371 | 1 Engr Science Elective Fundamentals of Speech Sp 211
Intro to High Speed Computing Stat 380 | 1 Socio-Humanistic Elective Seminar I E 392 | 1 Socio-Humanistic Elective Industrial Inspection Trip, I E 393
American Government Govt 215 | | R
Seminar I E 391 | | R

16 | 15 | 16
### FALL QUARTER Credits

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Industrial Engr Design I</td>
<td>5</td>
</tr>
<tr>
<td>I. E. 441</td>
<td></td>
</tr>
<tr>
<td>Manpower Management I</td>
<td>3</td>
</tr>
<tr>
<td>I. E 424</td>
<td></td>
</tr>
<tr>
<td>Thermodynamics I Phys 304</td>
<td>3</td>
</tr>
<tr>
<td>M. E. 321 or 321</td>
<td></td>
</tr>
<tr>
<td>2 Industrial Engr Elective</td>
<td>3</td>
</tr>
<tr>
<td>1 Socio-Humanistic Elective</td>
<td>3</td>
</tr>
<tr>
<td>Senior Year</td>
<td></td>
</tr>
</tbody>
</table>

### WINTER QUARTER Credits

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Industrial Engr Design II</td>
<td>5</td>
</tr>
<tr>
<td>I. E. 442</td>
<td></td>
</tr>
<tr>
<td>Manpower Management I</td>
<td>3</td>
</tr>
<tr>
<td>I. E 425</td>
<td></td>
</tr>
<tr>
<td>Industrial Operations Res. I. E 415</td>
<td>3</td>
</tr>
<tr>
<td>Writing of Scientific Papers, Engl. 414A</td>
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</tr>
<tr>
<td>Socio-Humanistic Elective</td>
<td>3</td>
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<tr>
<td>Seminar</td>
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<tr>
<td>I. E 492</td>
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### SPRING QUARTER Credits

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Engr. Science</td>
<td>4</td>
</tr>
<tr>
<td>Elective</td>
<td></td>
</tr>
<tr>
<td>2 Industrial Engr Elective</td>
<td>6</td>
</tr>
<tr>
<td>3 Supporting Elective</td>
<td>3</td>
</tr>
<tr>
<td>1 Socio-Humanistic Elective</td>
<td>3</td>
</tr>
</tbody>
</table>

1 These electives are to be chosen as sequences with advance approval from department-authorized lists.
2 Industrial Engineering electives are to be chosen from the following: 407, 416, 421, 422, 426, 443, 462, 480.
3 To be selected from department-approved list of courses; three credits of advanced ROTC may be used to satisfy this requirement.

### Curriculum in Mechanical Engineering

Leading to the degree Bachelor of Science. Total credits required, 205. See also Cooperative Programs and Basic Program.

### FALL QUARTER Credits

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anal Geom. &amp; Calc IV Math. 213</td>
<td>3</td>
</tr>
<tr>
<td>General Physics Phys 222</td>
<td>5</td>
</tr>
<tr>
<td>Statics of Engineering E M 274</td>
<td>4</td>
</tr>
<tr>
<td>Metal Processing I M. E. 232</td>
<td>3</td>
</tr>
<tr>
<td>Socio-Humanistic Elective</td>
<td>3</td>
</tr>
<tr>
<td>Sophomore Year</td>
<td></td>
</tr>
</tbody>
</table>

### WINTER QUARTER Credits

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intro to Applied Math I Math 321</td>
<td>3</td>
</tr>
<tr>
<td>American Government Govt. 215</td>
<td>3</td>
</tr>
<tr>
<td>Mechanics of Materials E. M. 324</td>
<td>5</td>
</tr>
<tr>
<td>Metal Processing II M. E. 233</td>
<td>3</td>
</tr>
<tr>
<td>Socio-Humanistic Elective</td>
<td>3</td>
</tr>
<tr>
<td>Junior Year</td>
<td></td>
</tr>
</tbody>
</table>

### SPRING QUARTER Credits

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intro to Applied Math. III Math. 410</td>
<td>3</td>
</tr>
<tr>
<td>Materials Laboratory E. M. 327</td>
<td>1</td>
</tr>
<tr>
<td>Dynamics of Engineering E. M. 414</td>
<td>4</td>
</tr>
<tr>
<td>Mech. Behavior of Metals M. E. 235</td>
<td>3</td>
</tr>
<tr>
<td>Analysis for Engr. Econ I. E. 304</td>
<td>3</td>
</tr>
<tr>
<td>Socio-Humanistic Elective</td>
<td>3</td>
</tr>
</tbody>
</table>
### Colleges and Curriculums

#### FALL QUARTER

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fluid Flow &amp; Heat Transfer</td>
<td>4</td>
</tr>
<tr>
<td>Fuels &amp; Combustion</td>
<td>4</td>
</tr>
<tr>
<td>Engr Instrumentation &amp; Measurements</td>
<td>3</td>
</tr>
<tr>
<td>Socio-Humanistic Elective</td>
<td>3</td>
</tr>
<tr>
<td>Professional Conduct</td>
<td>R</td>
</tr>
</tbody>
</table>

#### WINTER QUARTER

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mechanical Systems Design</td>
<td>4</td>
</tr>
<tr>
<td>Mech Engr Laboratory</td>
<td>2</td>
</tr>
<tr>
<td>2 Heat Power Elective</td>
<td>3</td>
</tr>
<tr>
<td>Socio-Humanistic Electives</td>
<td>6</td>
</tr>
<tr>
<td>Technical Electives</td>
<td>3</td>
</tr>
</tbody>
</table>

#### SPRING QUARTER

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical Metallurgy</td>
<td>4</td>
</tr>
<tr>
<td>l Engineering Contracts</td>
<td>3</td>
</tr>
<tr>
<td>Heat Power Laboratory</td>
<td>2</td>
</tr>
<tr>
<td>Socio-Humanistic Elective</td>
<td>3</td>
</tr>
<tr>
<td>Technical Electives</td>
<td>6</td>
</tr>
</tbody>
</table>

**Senior Electives**

- Sociology electives are to be chosen from the department-approved sequences.
- Technical electives will be chosen from one of the following groups:

  **Group 1**
  - M E 426, 427, 428, 429, 444, 445, 448, 521, 523, 524, 525, 540, 544, Nuc E 474, Aero E 409, 411

  **Group 2**
  - Ad 480, I E 407, 421, 424, 425, 441, 475, Psych 362, 474

  **Group 3**
  - M. E 411, 416, 513, 515, 516, 532, 533, E E 445, 446, 447, E S 484; E M 514, 517 or 518, 540, 544, 548

  **Group 4**

1 May be omitted by students appointed to advanced ROTC.
2 Choose one of M E 426, 444 or 445

#### Curriculum in Metallurgy

Leading to the degree Bachelor of Science. Total credits required, 198. See also Basic Program.

#### FALL QUARTER

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anal Geom &amp; Calc IV</td>
<td>3</td>
</tr>
<tr>
<td>Math 213</td>
<td></td>
</tr>
<tr>
<td>Introductory Metallurgy</td>
<td>3</td>
</tr>
<tr>
<td>Met 201</td>
<td></td>
</tr>
<tr>
<td>General Physics</td>
<td>5</td>
</tr>
<tr>
<td>Phys 223</td>
<td></td>
</tr>
<tr>
<td>1 Socio-Humanistic Elective</td>
<td>3</td>
</tr>
<tr>
<td>American Government</td>
<td>3</td>
</tr>
<tr>
<td>Govt 215</td>
<td></td>
</tr>
</tbody>
</table>

17

#### WINTER QUARTER

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intro to Applied Math I</td>
<td>3</td>
</tr>
<tr>
<td>Math 321</td>
<td></td>
</tr>
<tr>
<td>Introductory Metallurgy</td>
<td>3</td>
</tr>
<tr>
<td>Met 202</td>
<td></td>
</tr>
<tr>
<td>General Physics</td>
<td>5</td>
</tr>
<tr>
<td>Phys 222</td>
<td></td>
</tr>
<tr>
<td>1 Socio-Humanistic Elective</td>
<td>3</td>
</tr>
<tr>
<td>Statics of Engineering</td>
<td>4</td>
</tr>
<tr>
<td>E M 274</td>
<td></td>
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18

#### SPRING QUARTER

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>Intro to Applied Math III</td>
<td>3</td>
</tr>
<tr>
<td>Math 410</td>
<td></td>
</tr>
<tr>
<td>Introductory Metallurgy</td>
<td>3</td>
</tr>
<tr>
<td>Met 203</td>
<td></td>
</tr>
<tr>
<td>Elective</td>
<td>3</td>
</tr>
<tr>
<td>1 Socio-Humanistic Elective</td>
<td>3</td>
</tr>
<tr>
<td>Mechanics of Materials</td>
<td>5</td>
</tr>
<tr>
<td>E M 324</td>
<td></td>
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</tbody>
</table>

17

#### Sophomore Year

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical Chemistry</td>
<td>3</td>
</tr>
<tr>
<td>Chem 321</td>
<td></td>
</tr>
<tr>
<td>Modern Physics</td>
<td>3</td>
</tr>
<tr>
<td>Phys 301</td>
<td></td>
</tr>
<tr>
<td>Physical Metallurgy</td>
<td>3</td>
</tr>
<tr>
<td>Met 301</td>
<td></td>
</tr>
<tr>
<td>Physical Metallurgy Lab</td>
<td>2</td>
</tr>
<tr>
<td>Met 305</td>
<td></td>
</tr>
<tr>
<td>1 Socio-Humanistic Elective</td>
<td>3</td>
</tr>
<tr>
<td>2 Technical Elective</td>
<td>3</td>
</tr>
</tbody>
</table>

17

#### Junior Year

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical Chemistry</td>
<td>3</td>
</tr>
<tr>
<td>Chem 322</td>
<td></td>
</tr>
<tr>
<td>Modern Physics</td>
<td>3</td>
</tr>
<tr>
<td>Phys 302</td>
<td></td>
</tr>
<tr>
<td>Physical Metallurgy</td>
<td>3</td>
</tr>
<tr>
<td>Met 302</td>
<td></td>
</tr>
<tr>
<td>Physical Metallurgy Lab</td>
<td>2</td>
</tr>
<tr>
<td>Met 306</td>
<td></td>
</tr>
<tr>
<td>1 Socio-Humanistic Elective</td>
<td>3</td>
</tr>
<tr>
<td>2 Technical Elective</td>
<td>3</td>
</tr>
</tbody>
</table>

17
### FALL QUARTER

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engineering Metallurgy</td>
<td>3</td>
</tr>
<tr>
<td>Met. 401</td>
<td></td>
</tr>
<tr>
<td>A-c and D-c Circuits</td>
<td>4</td>
</tr>
<tr>
<td>E. E. 441</td>
<td></td>
</tr>
<tr>
<td>Socio-Humanistic Elective</td>
<td>3</td>
</tr>
<tr>
<td>Technical Electives</td>
<td>6</td>
</tr>
</tbody>
</table>

### WINTER QUARTER

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engineering Metallurgy</td>
<td>3</td>
</tr>
<tr>
<td>Met. 402</td>
<td></td>
</tr>
<tr>
<td>Electronic Circuits, Instruments and Systems</td>
<td>4</td>
</tr>
<tr>
<td>E. E. 445</td>
<td></td>
</tr>
<tr>
<td>Metal Thermochemistry</td>
<td>3</td>
</tr>
<tr>
<td>Met. 421</td>
<td></td>
</tr>
<tr>
<td>Socio-Humanistic Elective</td>
<td>3</td>
</tr>
<tr>
<td>Technical Electives</td>
<td>3</td>
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</table>

### SPRING QUARTER

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engineering Metallurgy</td>
<td>3</td>
</tr>
<tr>
<td>Met. 403</td>
<td></td>
</tr>
<tr>
<td>Socio-Humanistic Elective</td>
<td>3</td>
</tr>
<tr>
<td>Technical Electives</td>
<td>11</td>
</tr>
</tbody>
</table>

Total: 
- Fall Quarter: 16 Credits
- Winter Quarter: 16 Credits
- Spring Quarter: 17 Credits

1 These electives are to be selected from the department-approved list of socio-humanistic sequences.
2 Technical electives must include nine credits in metallurgy and three credits in written or spoken English beyond English 103.
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 as teachers of young children, home economics teachers in secondary schools and colleges, teachers of physical education for women, county extension home economists, dietitians, food service directors, school lunch supervisors, home service personnel with public utility companies, research workers, technicians in commercial laboratories, business home economists with food, equipment and textile companies, designers of textiles and of interiors, executives in retail clothing and home furnishings departments, members of editorial staffs of magazines and newspapers, and in recreation programs for children.

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, confer with faculty advisers concerning the program of studies for the coming year and become acquainted with the campus.
Curricula in Home Economics

<table>
<thead>
<tr>
<th>Curricula</th>
<th>Majors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Applied Art</td>
<td>Advertising Design</td>
</tr>
<tr>
<td></td>
<td>Art Education</td>
</tr>
<tr>
<td></td>
<td>General Applied Art and Crafts</td>
</tr>
<tr>
<td></td>
<td>Interior Design</td>
</tr>
<tr>
<td>Child Development</td>
<td>Child Development</td>
</tr>
<tr>
<td></td>
<td>Child Development—Elementary Education</td>
</tr>
<tr>
<td></td>
<td>Child Development and Related Science</td>
</tr>
<tr>
<td>Food and Nutrition</td>
<td>Community Nutrition</td>
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<tr>
<td></td>
<td>Dietetics</td>
</tr>
<tr>
<td></td>
<td>Food Science</td>
</tr>
<tr>
<td></td>
<td>Food and Nutrition and Related Science</td>
</tr>
<tr>
<td>Home Economics Education</td>
<td>Home Economics Education</td>
</tr>
<tr>
<td>Home Economics for General Education</td>
<td>Consumer Economics</td>
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<tr>
<td></td>
<td>Home Economics for General Education</td>
</tr>
<tr>
<td></td>
<td>Home Management</td>
</tr>
<tr>
<td></td>
<td>International Service</td>
</tr>
<tr>
<td>Home Economics Journalism</td>
<td>Home Economics Journalism</td>
</tr>
<tr>
<td>Household Equipment</td>
<td>Household Equipment</td>
</tr>
<tr>
<td></td>
<td>Household Equipment and Related Science</td>
</tr>
<tr>
<td>Institution Management</td>
<td>College Food and Housing Administration</td>
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<tr>
<td></td>
<td>Restaurant Management</td>
</tr>
<tr>
<td></td>
<td>School Food Service</td>
</tr>
<tr>
<td>Textiles and Clothing</td>
<td>Merchandising</td>
</tr>
<tr>
<td></td>
<td>Clothing</td>
</tr>
<tr>
<td></td>
<td>Textiles</td>
</tr>
<tr>
<td></td>
<td>Textile and Clothing Design</td>
</tr>
<tr>
<td></td>
<td>Textiles and Related Science</td>
</tr>
<tr>
<td>Physical Education for Women</td>
<td>Physical Education for Women</td>
</tr>
</tbody>
</table>

Cooperative Program

The College of Home Economics has cooperative programs with Morningside College and Central College. A student may take two years at either of these liberal arts colleges and two years at Iowa State University without the usual formalities of transferring.

A special grouping of courses is provided which makes it possible for a student to pursue any of the curricula offered by the College of Home Economics.

Applications for admission to the Cooperative Program in Home Economics should be addressed to 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 related science combined with child development, food and nutrition, household equipment or textiles; those who choose the curriculum in child development—elementary education, or 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."

1 Home Economics A A 103, C D 270, F & N 107,
   H. Ec. 105, 106, 400, and H Mgt 375
2 Biological Sciences Zoal 155, and 3 credits in Bacteriology,
   Biochemistry, Botany, Genetics or Zoology
All students are required to complete 6 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: Psychology 333, Education 305, 466, 467; Home Management 415.

In addition the following suggested courses should be considered in consultation with the Assistant Extension Director for Home Economics, an Extension Program Leader for Home Economics, or the Coordinator of Extension Personnel Training: Applied Art 261, Child Development 575, Ag. Ed. 211B., Food & Nutrition 208, 303; Household Equipment 254, Home Economics 240, Home Management 415, 488, 521, 522; Institution Management 380, Sociology 364, 464; Speech 312, Textiles & Clothing 123 or 125; Technical Journalism 225.

Summer appointment as assistants to county Extension personnel provides valuable experience for potential Extension staff members. It should be considered between the junior and senior year.

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, Household Equipment, and Textiles & 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 Training Program.

Home Economics and Related Science

These curricula are planned for students who wish to emphasize science in relation to Child Development, Food & Nutrition, Household Equipment, or Textiles. Students who have completed one of these majors have found interesting opportunities in research laboratories in colleges and universities, medical laboratories, foundations, and in industry. These majors also provide an excellent background for graduate study basic to professional advancement in the specified fields.

Students are advised to consult the head of the department in which they wish to place major emphasis before planning their program of study.

Each student must complete these courses as listed below:

1. H.Ec. 105, 106, 400; and 15 credits of home economics.
2. Physical Sciences Chem 101, 102, or 105, 106. Also Chem. 103, Math. 101, 102, 110, 211, and Phys. 111, 112
3. Social Sciences Govt. 215 and 12 credits of options from economics, history, psychology and sociology
4. Written and Spoken English Engl 101, 102, 103, Sp 211
5. Foreign Languages French, German or Russian. (See explanation above regarding physical education and library)

Curriculum in Applied Art

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

### Home Economics

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>A A 103</td>
<td>Design I</td>
<td>4</td>
</tr>
<tr>
<td>A A 104</td>
<td>Design II</td>
<td>3</td>
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<tr>
<td>A A 107</td>
<td>Lettering I</td>
<td>3</td>
</tr>
<tr>
<td>A A 150</td>
<td>Drawing I</td>
<td>3</td>
</tr>
<tr>
<td>A A 203</td>
<td>Color</td>
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<tr>
<td>A A 250</td>
<td>Drawing II</td>
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<td>A A 384</td>
<td>Survey of Art</td>
<td>3</td>
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<td>A A 401</td>
<td>Study Tour</td>
<td>R</td>
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<td>A A 404</td>
<td>Seminar</td>
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<tr>
<td>C D 270</td>
<td>The Individual and His Family I</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 Ec 105</td>
<td>Orientation to Home Economics</td>
<td>1</td>
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<tr>
<td>H Ec 106</td>
<td>Careers in Home Economics</td>
<td>R</td>
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<tr>
<td>H Ec 400</td>
<td>Professional Relations</td>
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<tr>
<td>H Mgt 375</td>
<td>Management in the Family</td>
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### Biological Sciences

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<th>Course Name</th>
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<tbody>
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<td>Bact,</td>
<td>Biology</td>
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<tr>
<td>Biochem,</td>
<td>Microbiology</td>
<td>3</td>
</tr>
<tr>
<td>Bot, Gen</td>
<td>Botany</td>
<td>3</td>
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<tr>
<td>Zool</td>
<td>Zoology</td>
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### Physical Sciences

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<tbody>
<tr>
<td>Biochem,</td>
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<tr>
<td>Chem</td>
<td>Chemistry</td>
<td>3</td>
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<td>Earth Sc1ence</td>
<td>Earth Science</td>
<td>3</td>
</tr>
<tr>
<td>Math</td>
<td>Mathematics</td>
<td>3</td>
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<tr>
<td>Phys</td>
<td>Physics</td>
<td>3</td>
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<td>Stat</td>
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### Social Sciences

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<th>Credits</th>
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<tbody>
<tr>
<td>Econ 241, 242</td>
<td>Principles of Economics</td>
<td>6</td>
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<tr>
<td>Govt 215</td>
<td>American Government</td>
<td>3</td>
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<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>
</tr>
<tr>
<td>Soc 218</td>
<td>Introduction to Cultural Anthropology</td>
<td>3</td>
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### Humanities

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<tr>
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<th>Credits</th>
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<td>Phil, Lit., F. L., Music</td>
<td>Philosophy, Literature, Fine Arts, Music</td>
<td>9</td>
</tr>
<tr>
<td>Hist. 205, 206</td>
<td>Introduction to Western Civilization</td>
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### Written and Spoken English

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<th>Course Name</th>
<th>Credits</th>
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<tr>
<td>Engl 101, 102, 103</td>
<td>Principles of Composition</td>
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<tr>
<td>Sp 211</td>
<td>Fundamentals of Speech</td>
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<td>Lib 106</td>
<td>Library Instruction</td>
<td>R</td>
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### Technical Journalism

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<tr>
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<th>Course Name</th>
<th>Credits</th>
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<tbody>
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<td>T Jl 225</td>
<td>Publicity &amp; Public Relations</td>
<td>3</td>
</tr>
<tr>
<td>T Jl 317</td>
<td>Photography</td>
<td>4</td>
</tr>
<tr>
<td>T Jl 325</td>
<td>Tech Advertising</td>
<td>3</td>
</tr>
<tr>
<td>T Jl 342</td>
<td>Typography</td>
<td>3</td>
</tr>
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</table>

### Electives

<table>
<thead>
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<th>Course Name</th>
<th>Credits</th>
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<tbody>
<tr>
<td>A A 213</td>
<td>Fashion Illustration I</td>
<td>3</td>
</tr>
<tr>
<td>A A 214</td>
<td>Fashion Illustration II</td>
<td>3</td>
</tr>
<tr>
<td>A A 490G</td>
<td>Special Problems</td>
<td>4</td>
</tr>
<tr>
<td>T &amp; C 104</td>
<td>Textiles</td>
<td>3</td>
</tr>
<tr>
<td>T &amp; C 454</td>
<td>History of Costume</td>
<td>3</td>
</tr>
</tbody>
</table>

### 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.

Students interested in an emphasis in Fashion Illustration would be required to take 16 additional credits and should declare this intention by the first quarter of the junior year.

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

### Home Economics

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>A A 207</td>
<td>Lettering II</td>
<td>3</td>
</tr>
<tr>
<td>A A 233</td>
<td>Watercolor</td>
<td>3</td>
</tr>
<tr>
<td>A A 306</td>
<td>Advertising Design I</td>
<td>3</td>
</tr>
<tr>
<td>A A 324</td>
<td>Figure Drawing</td>
<td>3</td>
</tr>
<tr>
<td>A A 325</td>
<td>Drawing III</td>
<td>3</td>
</tr>
<tr>
<td>A A 406</td>
<td>Advertising Design II</td>
<td>3</td>
</tr>
<tr>
<td>A A 484</td>
<td>History of Ornament</td>
<td>3</td>
</tr>
<tr>
<td>A A 485</td>
<td>Medieval, Renaissance and Oriental Art</td>
<td>3</td>
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<td>A A 486</td>
<td>Modern Art</td>
<td>3</td>
</tr>
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<td>A A 490F</td>
<td>Spec. Prob in Adv</td>
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### Social Sciences

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<th>Course Name</th>
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<tbody>
<tr>
<td>Psych 250</td>
<td>Psychology of Sales and Advertising</td>
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### Technical Journalism

<table>
<thead>
<tr>
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<tr>
<td>A A 490G</td>
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</tr>
<tr>
<td>A A 490G</td>
<td>Special Problems</td>
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</tr>
<tr>
<td>T &amp; C 104</td>
<td>Textiles</td>
<td>3</td>
</tr>
<tr>
<td>T &amp; C 454</td>
<td>History of Costume</td>
<td>3</td>
</tr>
</tbody>
</table>
Major in Art Education

The major in Art Education is planned for students preparing to teach art in grades seven through 14. Further information appears in the sections on Teacher Education, and Applied Art. Description of Courses.

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>A A 207 Lettering II</td>
<td>3</td>
</tr>
<tr>
<td>A A 233 Watercolor</td>
<td>3</td>
</tr>
<tr>
<td>A A 261 Interior House Des I</td>
<td>3</td>
</tr>
<tr>
<td>A A 306 Advertising Des I</td>
<td>3</td>
</tr>
<tr>
<td>A A 324 Figure Drawing</td>
<td>3</td>
</tr>
<tr>
<td>A A 325 Drawing III</td>
<td>3</td>
</tr>
<tr>
<td>A A 335 Textile Design I</td>
<td>4</td>
</tr>
<tr>
<td>A A 344 Weaving</td>
<td>3</td>
</tr>
<tr>
<td>A A 345 Wood and Metal</td>
<td>4</td>
</tr>
<tr>
<td>A A 393 Ceramics</td>
<td>3</td>
</tr>
<tr>
<td>A A 424 Oil Painting</td>
<td>3</td>
</tr>
<tr>
<td>A A 445 Advanced Craft Des</td>
<td>3</td>
</tr>
<tr>
<td>A A 446 Jewelry</td>
<td>3</td>
</tr>
<tr>
<td>A A 485 Medieval, Renaissance &amp; Oriental Art</td>
<td>3</td>
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<tr>
<td>A A 486 Modern Art</td>
<td>3</td>
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</table>

Professional Education

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
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<tbody>
<tr>
<td>A A.416 Art Methods for the Secondary School</td>
<td>3</td>
</tr>
<tr>
<td>A A.417 Supervised Teaching in Art</td>
<td>9</td>
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<tr>
<td>Ed 204 Foundations of American Education</td>
<td>3</td>
</tr>
<tr>
<td>Ed 305 Methods of Teaching</td>
<td>4</td>
</tr>
<tr>
<td>Ed 426 Principles of Secondary Education</td>
<td>3</td>
</tr>
<tr>
<td>Psych 230 Developmental Psychology</td>
<td>3</td>
</tr>
<tr>
<td>Psych 333 Educational Psychology</td>
<td>3</td>
</tr>
</tbody>
</table>

Electives

13 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 would permit 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:

Home Economics

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>A A 207 Lettering II</td>
<td>3</td>
</tr>
<tr>
<td>A A 261 Int House Design I</td>
<td>3</td>
</tr>
<tr>
<td>A A 335 Textile Design I</td>
<td>3</td>
</tr>
<tr>
<td>A A 344 Weaving</td>
<td>3</td>
</tr>
<tr>
<td>A A 345 Wood and Metal</td>
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</tr>
<tr>
<td>A A 393 Ceramics</td>
<td>3</td>
</tr>
<tr>
<td>A A 435 Textile Design II</td>
<td>3</td>
</tr>
<tr>
<td>A A 445 Adv Craft Design</td>
<td>3</td>
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<tr>
<td>A A 446 Jewelry</td>
<td>3</td>
</tr>
<tr>
<td>A A 484 History of Ornament</td>
<td>3</td>
</tr>
<tr>
<td>A A 485 Medieval, Renaissance &amp; Oriental Art</td>
<td>3</td>
</tr>
<tr>
<td>A A 486 Modern Art</td>
<td>3</td>
</tr>
<tr>
<td>A A 490C Special Problems</td>
<td>8</td>
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<tr>
<td>T &amp; C 104 Textiles</td>
<td>3</td>
</tr>
<tr>
<td>* T &amp; C 414 Historic Textiles</td>
<td>3</td>
</tr>
</tbody>
</table>

Electives

36-39 Credits

*T & C 414 required for weaving students
Major in Interior Design

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

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>A A 233 Watercolor</td>
<td>3</td>
</tr>
<tr>
<td>A A 261 Int House Design I</td>
<td>3</td>
</tr>
<tr>
<td>A A 335 Textile Design I</td>
<td>4</td>
</tr>
<tr>
<td>A A 361 Hist of Furniture</td>
<td>3</td>
</tr>
<tr>
<td>A A 435 Textile Design II</td>
<td>3</td>
</tr>
<tr>
<td>A A 464, Interior Design I</td>
<td>3</td>
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<tr>
<td>A A 465 Interior Design II</td>
<td>3</td>
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<tr>
<td>A A 466 Apprenticeship</td>
<td>9</td>
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<td>A A 490E Special Problems</td>
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<tr>
<td>T &amp; C 104 Textiles</td>
<td>3</td>
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<tr>
<td>T &amp; C 414 Historic Textiles</td>
<td>3</td>
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<tr>
<td>Arch 361 Residential Architecture</td>
<td>3</td>
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<tr>
<td>Social Sciences</td>
<td>3</td>
</tr>
<tr>
<td>Psych 250 Psych of Sales and Advertising</td>
<td>3</td>
</tr>
<tr>
<td>Electives</td>
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</tr>
</tbody>
</table>

Curriculum in Child Development

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

Three majors are offered in the Child Development Department: Child Development, Child Development—Elementary Education, Child Development and Related Science.

<table>
<thead>
<tr>
<th>Home Economics</th>
<th>Credits</th>
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<tbody>
<tr>
<td>A A 103 Design I</td>
<td>4</td>
</tr>
<tr>
<td>C D 236 Principles of Child Development</td>
<td>3</td>
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<tr>
<td>C D 240 Literature for Children</td>
<td>4</td>
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<tr>
<td>C D 270 The Individual and His Family I</td>
<td>4</td>
</tr>
<tr>
<td>C D 336 Development in Early Childhood</td>
<td>3</td>
</tr>
<tr>
<td>C D 337 Development and Guidance in Later Childhood</td>
<td>3</td>
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<tr>
<td>C D 460 Guidance of Children</td>
<td>4</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 106 Careers in Home Economics</td>
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<tr>
<td>H Ec 105 Orientation to Home Economics</td>
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<tr>
<td>Biological Sciences</td>
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<tr>
<td>Zool 155 Elementary Human Physiology and Anatomy</td>
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<td>Social Sciences</td>
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<td>Econ 241 Principles of Economics</td>
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<td>Govt 215 American Government</td>
<td>3</td>
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<td>Psych 101 General Psychology I</td>
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</tr>
<tr>
<td>Psych 230 Developmental Psychology</td>
<td>3</td>
</tr>
<tr>
<td>Soc 134 Introduction to Sociology</td>
<td>3</td>
</tr>
<tr>
<td>Soc 218 Introduction to Cultural Anthropology</td>
<td>3</td>
</tr>
<tr>
<td>Written and Spoken English</td>
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</tr>
<tr>
<td>Engl. 101, 102, 103 Principles of Composition</td>
<td>9</td>
</tr>
<tr>
<td>Sp 211 Fundamentals of Speech</td>
<td>3</td>
</tr>
<tr>
<td>Library 106 Library Instruction</td>
<td>R</td>
</tr>
<tr>
<td>P E</td>
<td>6</td>
</tr>
</tbody>
</table>

Major in Child Development

This major is for the student who is interested in working with children up to age 12 in a wide variety of agencies, institutions, hospitals, or programs for children.

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

<table>
<thead>
<tr>
<th>Home Economics</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>C D 366 Activities and Materials</td>
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<tr>
<td>C D 368 Study Tour</td>
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<tr>
<td>C D 461 Curriculum Planning for the Preschool Child</td>
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</tr>
<tr>
<td>C D 467A Supervised Teaching in Nursery School</td>
<td>6</td>
</tr>
</tbody>
</table>
Major in Child Development—Elementary Education

This major in Child Development—Elementary Education is planned for students interested in preparation for teaching in the elementary grades, kindergarten through sixth. Students should enter the Child Development—Elementary Education program by the end of the sophomore year, but must apply to, and be accepted by, the department committee on selection and the University Committee on Teacher Education.

In addition to the curriculum requirements in Child Development the following courses are to be completed:

Professional Education

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ed. 204 Foundations of American Education</td>
<td>3</td>
</tr>
<tr>
<td>Ed. 305 Methods of Teaching</td>
<td>1</td>
</tr>
<tr>
<td>CD 366 Activities, Materials</td>
<td>3</td>
</tr>
<tr>
<td>CD 375 The Teaching of Reading</td>
<td>5</td>
</tr>
<tr>
<td>CD 444 Principles of Teaching in the Elementary School</td>
<td>2</td>
</tr>
<tr>
<td>CD 445, 446 Elementary Education Methods I, II</td>
<td>8</td>
</tr>
<tr>
<td>CD 467C Student Teaching in the Primary Grades</td>
<td>8</td>
</tr>
<tr>
<td>CD 467D Student Teaching in the Intermediate Grades</td>
<td>8</td>
</tr>
<tr>
<td>Psych 333 Educational Psychology</td>
<td>3</td>
</tr>
</tbody>
</table>

Biological Sciences

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bot 101 General Botany</td>
<td>3</td>
</tr>
<tr>
<td>Zool 101 General Zoology</td>
<td>5</td>
</tr>
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Physical Sciences

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chem 101 or 105 General Chemistry</td>
<td>3</td>
</tr>
<tr>
<td>Geol 100 Introduction to Geology</td>
<td>3</td>
</tr>
<tr>
<td>Select from other Earth Science</td>
<td>3</td>
</tr>
<tr>
<td>Math. 190, Mathematical Concepts</td>
<td>3</td>
</tr>
<tr>
<td>Math 191 or 192 Mathematical Concepts</td>
<td>3</td>
</tr>
<tr>
<td>Physics 106 Elementary Physics</td>
<td>4</td>
</tr>
</tbody>
</table>

Humanities

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engl 201 Introduction to Literature</td>
<td>3</td>
</tr>
<tr>
<td>Hist</td>
<td>6</td>
</tr>
<tr>
<td>Phil 260 Introduction to Philosophy</td>
<td>4</td>
</tr>
</tbody>
</table>

Music 365 Music in the Elementary Schools

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Written and Spoken English</td>
<td>3</td>
</tr>
</tbody>
</table>

Music 365 Music in the Elementary Schools

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sp 375 Speech Correction Principles</td>
<td>3</td>
</tr>
<tr>
<td>PE 470 Elementary School Physical Education</td>
<td>3</td>
</tr>
</tbody>
</table>

Academic Area of Concentration

To be used to develop further an area of concentration such as languages, art, social studies, sciences, mathematics. To be selected with approval of adviser.

Electives

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>19</td>
</tr>
</tbody>
</table>
**Major in Child Development and Related Sciences**

This major is for the student who is planning graduate study in Child Development, or one of its allied fields. It provides a strong background on which to build a graduate program.

**Home Economics**
- CD 270 The Individual and His Family I 3 Credits
- CD 336 Development in Early Childhood 3 Credits
- CD 337 Development and Guidance in Later Childhood 3 Credits
- CD 368 Study Tour 4 Credits
- CD 460 Guidance of Children 2 Credits
- CD 465 Seminar 15 Credits
- H Ec courses other than those in the major area R
- H Ec 105 Orientation to Home Economics 1 Credit
- H Ec 106 Careers in Home Economics R
- H Ec 400 Professional Relations R

**Biological Sciences**
- Bact 200 Introductory Bacteriology I 3 Credits
- Zool 155 Elementary Human Physiology and Anatomy 5 Credits
- Zool 355 Principles of Physiology 4 Credits
- Zool 359 Kinesiology 5 Credits

**Physical Sciences**
- Chem 101, 102 General Chemistry 8 Credits
- Chem 105, 106 General Chemistry 6 Credits
- Chem 103 Systematic Inorganic Chemistry 4 Credits
- Math 101 Algebra and Trigonometry I 5 Credits
- Math 102 Algebra and Trigonometry II 5 Credits
- *Math 110 Analytic Geometry and Calculus I 5 Credits
- *Math 211 Analytic Geometry and Calculus II 5 Credits
- Phys 111, 112 General Physics 8 Credits

**Social Sciences**
- Govt 215 American Government 3 Credits
- Psych 101 General Psychology I 3 Credits
- Psych 201 General Psychology II 3 Credits
- Psych 301 Experimental Psychology 3 Credits
- Psych 415 Psychology of Exceptional Children 3 Credits
- Psych 440 Psychological Measurement I 3 Credits
- Psych 441 Opinion, Attitude and Motivation Analysis 3 Credits
- Soc 134 Introduction to Sociology 3 Credits
- Soc 218 Introduction to Cultural Anthropology 3 Credits
- Soc 220 Prehistoric Man 3 Credits
- Soc 421 Kinship and the Family in Different Cultures I or 3 Credits
- Soc 422 Culture and Personality 3 Credits

**Written and Spoken English**
- Engl 101, 102, 103 Principles of Composition 9 Credits
- Engl 414 Writing of Scientific Papers 3 Credits
- Sp 211 Fundamentals of Speech 3 Credits

**Lib**
- Lib 106 Library Instruction R

**FL**
- FL 201, 202 French I or II
- 231, 232 German I or II
- 221, 222 Russian I

**PE**
- PE 8 Credits

**Electives**
- 8 Credits

* May substitute Stat 201 and Stat 401 for Math 110, 211, respectively

**Curriculum in Food and Nutrition**

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

Four majors are offered in the Food and Nutrition Department: Food Science, Community Nutrition, Dietetics, 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.
**Home Economics**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>AA 103</td>
<td>Design 1</td>
<td></td>
</tr>
<tr>
<td>CD 270</td>
<td>The Individual and His Family 1</td>
<td></td>
</tr>
<tr>
<td>F &amp; N 107</td>
<td>Nutrition and the Family’s Food</td>
<td></td>
</tr>
<tr>
<td>F &amp; N 214</td>
<td>Foods I, II</td>
<td></td>
</tr>
<tr>
<td>F &amp; N 303</td>
<td>Family Meal Management</td>
<td></td>
</tr>
<tr>
<td>F &amp; N 305</td>
<td>Nutrition and Dietetics</td>
<td></td>
</tr>
<tr>
<td>F &amp; N 404</td>
<td>Seminar in Food and Nutrition</td>
<td></td>
</tr>
<tr>
<td>H Ec 105</td>
<td>Orientation to Home Economics</td>
<td></td>
</tr>
<tr>
<td>H Ec 106</td>
<td>Careers in Home Economics</td>
<td></td>
</tr>
<tr>
<td>H Ec 400</td>
<td>Professional Relations</td>
<td></td>
</tr>
<tr>
<td>H, Mgt 375</td>
<td>Management in the Family</td>
<td></td>
</tr>
<tr>
<td>H Eq 254</td>
<td>Basic Physical Principles</td>
<td></td>
</tr>
<tr>
<td>I Mgt 380</td>
<td>Quantity Food Production</td>
<td></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>Bact 304</td>
<td>General Bacteriology</td>
<td></td>
</tr>
<tr>
<td>Zool 155</td>
<td>Elementary Human Physiology and Anatomy</td>
<td></td>
</tr>
</tbody>
</table>

**Physical Sciences**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chem 105, 106</td>
<td>General Chemistry</td>
<td></td>
</tr>
<tr>
<td>Chem 231</td>
<td>Elementary Organic Chemistry</td>
<td></td>
</tr>
<tr>
<td>B &amp; B 301</td>
<td>Biochemistry</td>
<td></td>
</tr>
<tr>
<td>B &amp; B 311</td>
<td>Laboratory in Biochemistry</td>
<td></td>
</tr>
<tr>
<td>Chem 103</td>
<td>Systematic Inorganic Chemistry</td>
<td></td>
</tr>
<tr>
<td>Chem 334, 335</td>
<td>Organic Chemistry</td>
<td></td>
</tr>
<tr>
<td>B &amp; B 304, 305</td>
<td>Physiological Chemistry</td>
<td></td>
</tr>
<tr>
<td>B &amp; B 311</td>
<td>Laboratory in Biochemistry</td>
<td></td>
</tr>
<tr>
<td>Phys 106</td>
<td>Elementary Physics</td>
<td></td>
</tr>
</tbody>
</table>

**Social Sciences**

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

**Humanities**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>History</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Philosophy, Literature, Foreign Language, Music</td>
<td>9 Credits</td>
<td></td>
</tr>
<tr>
<td>Written and Spoken English</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Engl 101, 102, 103</td>
<td>Principles of Composition</td>
<td>9 Credits</td>
</tr>
<tr>
<td>Sp 211</td>
<td>Fundamentals of Speech</td>
<td>3 Credits</td>
</tr>
<tr>
<td>Lib 106 Library Instruction</td>
<td></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:

**Home Economics**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>CD 236</td>
<td>Principles of Child Development</td>
<td></td>
</tr>
<tr>
<td>F &amp; N 400A</td>
<td>Field Study Tour</td>
<td></td>
</tr>
<tr>
<td>F &amp; N 409</td>
<td>Diet Therapy</td>
<td></td>
</tr>
<tr>
<td>F &amp; N 410</td>
<td>Nutrition During Human Growth and Development</td>
<td>3 Credits</td>
</tr>
<tr>
<td>F &amp; N 411</td>
<td>Experimental Study of Foods</td>
<td></td>
</tr>
<tr>
<td>F &amp; N 413</td>
<td>Community Nutrition</td>
<td></td>
</tr>
<tr>
<td>F &amp; N 414</td>
<td>Seminar in Community Nutrition</td>
<td></td>
</tr>
<tr>
<td>H Mgt 488</td>
<td>Family Finance</td>
<td></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 355</td>
<td>Principles of Physiology</td>
<td></td>
</tr>
</tbody>
</table>

**Social Sciences**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Psych 230</td>
<td>Developmental Psychology</td>
<td></td>
</tr>
<tr>
<td>Psych 333</td>
<td>Educational Psychology</td>
<td></td>
</tr>
</tbody>
</table>
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:

Home Economics
- C D 236 Principles of Child Development: 3 Credits
- F & N 400A Field Study Tour: R
- F & N 409 Diet Therapy: 3 Credits
- F & N 410 Nutrition During Human Growth and Development: 3 Credits
- F & N 411 Experimental Studies of Food: 4 Credits
- F & N 418 Methods of Teaching Nutrition: 3 Credits
- H Ed 415 Principles of Education for Dietitians: 2 Credits
- I Mgt 484 Purchasing: 4 Credits
- I Mgt 487 Organization and Management: 3 Credits
- I Mgt 488 Personnel Management in Institutions: 3 Credits
- I Mgt 485 Equipment 4 Credits or
- I Mgt 580 Quantity Food Development: 3 Credits or
- 1 Ad 384 General Accounting: 4 Credits

Biological Sciences
- Zool 355 Principles of Physiology: 4 Credits

Speech Elective
- T Jl 225 Publicity and Public Relations or English or Speech: 3 Credits

Electives
- Select 5 credits from physical and biological science, economics, mathematics or statistics: 5 Credits

*Students may take part of Chemistry Sequence II and complete remaining requirements in Sequence I. Students who earn a grade of A or B in Chem 105, 106 may enroll in Chem 103 and continue in Sequence II. Sequence II fulfills option of 5 credits from physical and biological sciences in major.

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
- F & N 320 Fundamentals of Food Measurements: 3 Credits
- F & N 400B Field Study Tour: R
- F & N 410 Nutrition During Human Growth and Development: 3 Credits
- F & N 413 Community Nutrition: 3 Credits
- F & N 420 History of Food: 2 Credits
- F & N 421, 422 Principles of Food Science I, II: 8 Credits
- F & N 423 Introduction to Research in Food Science: 3 Credits
- H Mgt 488 Family Finance: 3 Credits

Speech Elective
- T Jl 225 Publicity and Public Relations: 3 Credits

Electives
- Select 5 credits from physical and biological science, economics, mathematics or statistics: 5 Credits

*Students may take part of Chemistry Sequence II and complete remaining requirements in Sequence I. Students who earn a grade of A or B in Chem 105, 106 may enroll in Chem 103 and continue in Sequence II. Sequence II fulfills option of 5 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 in industry. They also have an excellent 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

Major in Food and Nutrition and Related Science

<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>A A 384</td>
<td>Survey of Art</td>
<td>3</td>
</tr>
<tr>
<td>F &amp; N 214</td>
<td>Foods I, II</td>
<td>8</td>
</tr>
<tr>
<td>F &amp; N 303</td>
<td>Family Meal Management</td>
<td>3</td>
</tr>
<tr>
<td>F &amp; N 305</td>
<td>Nutrition and Dietetics</td>
<td>4</td>
</tr>
<tr>
<td>F &amp; N 404</td>
<td>Seminar in Food and Nutrition</td>
<td>2</td>
</tr>
<tr>
<td>F &amp; N 411</td>
<td>Experimental Studies of Food</td>
<td>4</td>
</tr>
<tr>
<td>F &amp; N 415</td>
<td>Introduction to Nutrition Research</td>
<td>3</td>
</tr>
<tr>
<td>Select from F &amp; N 409, 410, 413</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>H Ec 105</td>
<td>Orientation to Home Economics</td>
<td>1</td>
</tr>
<tr>
<td>H Ec 106</td>
<td>Careers in Home Economics</td>
<td>. R</td>
</tr>
<tr>
<td>H Ec 400</td>
<td>Professional Relations</td>
<td>R</td>
</tr>
</tbody>
</table>

Courses in H Ec other than those in major area 11 12 Credits

Biological Sciences

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bact 304</td>
<td>General Bacteriology</td>
<td>5</td>
</tr>
<tr>
<td>Zool 101</td>
<td>General Zoology</td>
<td>10</td>
</tr>
<tr>
<td>Zool 355</td>
<td>Principles of Physiology</td>
<td>4</td>
</tr>
</tbody>
</table>

Physical Sciences

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chem 101</td>
<td>General Chemistry</td>
<td>8</td>
</tr>
<tr>
<td>Chem 102</td>
<td>General Chemistry</td>
<td>6</td>
</tr>
<tr>
<td>Chem 103</td>
<td>Systematic Inorganic Chemistry</td>
<td>4</td>
</tr>
<tr>
<td>Chem 211</td>
<td>Quantitative Analysis</td>
<td>. 5</td>
</tr>
<tr>
<td>Chem 334</td>
<td>Organic Chemistry</td>
<td>12</td>
</tr>
<tr>
<td>B &amp; B 304</td>
<td>Physiological Chemistry</td>
<td>6</td>
</tr>
<tr>
<td>Math 101</td>
<td>Algebra and Trigonometry I, II</td>
<td>10</td>
</tr>
<tr>
<td>Math 110</td>
<td>Analytic Geometry and Calculus I, II</td>
<td>10</td>
</tr>
<tr>
<td>Phys 111</td>
<td>General Physics</td>
<td>8</td>
</tr>
</tbody>
</table>

Social Sciences and Humanities

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Govt 215</td>
<td>American Government</td>
<td>3</td>
</tr>
<tr>
<td>History</td>
<td></td>
<td>6</td>
</tr>
<tr>
<td>Additional</td>
<td></td>
<td>6</td>
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</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 101</td>
<td>Principles of Composition</td>
<td>9</td>
</tr>
<tr>
<td>Sp 211</td>
<td>Fundamentals of Speech</td>
<td>3</td>
</tr>
</tbody>
</table>

Lib 106 Library Instruction R

F L 201, 202 French or 231, 232 German or 221A, 222A Russian 6 Credits

P E 6 Credits

Electives 33 37 Credits

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 homemaking in junior and senior high schools or Home Economics Extension Service.

Further information appears in the sections on Teacher Education and Home Economics Education, Courses and Programs.

Home Economics

Major in Food and Nutrition and Related Science

<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>A A 261</td>
<td>Interior House Design I</td>
<td>.3</td>
</tr>
<tr>
<td>Select from A.A. 104, 384</td>
<td></td>
<td>.3</td>
</tr>
</tbody>
</table>

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

The curriculum is planned for those who wish to prepare for teaching homemaking in junior and senior high schools or Home Economics Extension Service.

Further information appears in the sections on Teacher Education and Home Economics Education, Courses and Programs.

Home Economics

Major in Food and Nutrition and Related Science

<table>
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<tr>
<th>Course Code</th>
<th>Course Title</th>
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</thead>
<tbody>
<tr>
<td>A A 103</td>
<td>Design I</td>
<td>4</td>
</tr>
<tr>
<td>A A 261</td>
<td>Interior House Design I</td>
<td>.3</td>
</tr>
<tr>
<td>Select from A.A. 104, 384</td>
<td></td>
<td>.3</td>
</tr>
<tr>
<td>Course Code</td>
<td>Course Title</td>
<td>Credits</td>
</tr>
<tr>
<td>-------------</td>
<td>--------------------------------------------------</td>
<td>---------</td>
</tr>
<tr>
<td>CD 236</td>
<td>Principles of Child Development</td>
<td>3</td>
</tr>
<tr>
<td>CD 270</td>
<td>The Individual and His Family 1</td>
<td>4</td>
</tr>
<tr>
<td>CD 337</td>
<td>Development and Guidance in later Childhood</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>3</td>
</tr>
<tr>
<td>F &amp; N 305</td>
<td>Nutrition and Dietetics</td>
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</tr>
<tr>
<td>H Ec 105</td>
<td>Orientation to Home Economics</td>
<td>1</td>
</tr>
<tr>
<td>H Ec 106</td>
<td>Careers in Home Economics</td>
<td>R</td>
</tr>
<tr>
<td>H Ec 400</td>
<td>Professional Relations</td>
<td>4</td>
</tr>
<tr>
<td>H Mgt 375</td>
<td>Management in the Family</td>
<td>4</td>
</tr>
<tr>
<td>H Mgt 475</td>
<td>Home Management House</td>
<td>3</td>
</tr>
<tr>
<td>H Mgt 488</td>
<td>Family Finance</td>
<td>3</td>
</tr>
<tr>
<td>H Eq 254</td>
<td>Principles in Equipment</td>
<td>3</td>
</tr>
<tr>
<td>Housing</td>
<td>Select from A A 262, Arch 361, H Ec 240, H Eq 318</td>
<td>3</td>
</tr>
<tr>
<td>345, 446</td>
<td>H Mgt 521</td>
<td>3</td>
</tr>
<tr>
<td>T &amp; C 104</td>
<td>Textiles 1</td>
<td>3</td>
</tr>
<tr>
<td>T &amp; C 245</td>
<td>Clothing Selection</td>
<td>3</td>
</tr>
<tr>
<td>T &amp; C 123</td>
<td>Pattern Making and Clothing Construction (5 Credits)</td>
<td>4</td>
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<tr>
<td>T &amp; C 125</td>
<td>Pattern Making and Clothing Construction (4 Credits)</td>
<td>4-5</td>
</tr>
<tr>
<td>T &amp; C 225</td>
<td>Draping and Clothing Construction (3 Credits)</td>
<td>3</td>
</tr>
<tr>
<td>T &amp; C 223</td>
<td>Pattern Making (4 Credits)</td>
<td>3-4</td>
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<tr>
<td>Professional Education</td>
<td></td>
<td>35 Credits</td>
</tr>
<tr>
<td>Ed 204</td>
<td>Foundations of American Education</td>
<td>3</td>
</tr>
<tr>
<td>Ed 305</td>
<td>Methods of Teaching</td>
<td>4</td>
</tr>
<tr>
<td>Ed 426</td>
<td>Principles of Secondary Education</td>
<td>3</td>
</tr>
<tr>
<td>H Ec 406</td>
<td>Observation and Methods of Teaching Home Economics</td>
<td>4</td>
</tr>
<tr>
<td>*H Ec 407</td>
<td>Supervised Teaching in Home Economics</td>
<td>9</td>
</tr>
<tr>
<td>H Ec 408</td>
<td>Methods in Adult Homemaking Education</td>
<td>3</td>
</tr>
<tr>
<td>H Ec 409</td>
<td>Planning and Evaluating the Homemaking Program</td>
<td>3</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>Biological Sciences</td>
<td></td>
<td>8 Credits</td>
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<tr>
<td>Bact 200</td>
<td>Introductory Bacteriology 1</td>
<td>3</td>
</tr>
<tr>
<td>Zool 155</td>
<td>Elementary Human Physiology and Anatomy</td>
<td>5</td>
</tr>
<tr>
<td>Physical Sciences</td>
<td></td>
<td>17 Credits</td>
</tr>
<tr>
<td>Chem 105, 106</td>
<td>General Chemistry</td>
<td>6</td>
</tr>
<tr>
<td>Chem 231</td>
<td>Elementary Organic Chemistry</td>
<td>4</td>
</tr>
<tr>
<td>B &amp; B 301</td>
<td>Biochemistry</td>
<td>3</td>
</tr>
<tr>
<td>Phys 106</td>
<td>Elementary Physics</td>
<td>4</td>
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<tr>
<td>Social Science</td>
<td></td>
<td>18 Credits</td>
</tr>
<tr>
<td>Econ 241, 242</td>
<td>Principles of Economics</td>
<td>6</td>
</tr>
<tr>
<td>Govt 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>
<tr>
<td>Soc 218</td>
<td>Introduction to Cultural Anthropology</td>
<td>3</td>
</tr>
<tr>
<td>Humanities</td>
<td>Choose from at least three areas</td>
<td>15 Credits</td>
</tr>
<tr>
<td>History, Philosophy, Literature, Foreign Languages, Music</td>
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<td></td>
</tr>
<tr>
<td>Written and Spoken English</td>
<td></td>
<td>15 Credits</td>
</tr>
<tr>
<td>Engl 101, 102, 103</td>
<td>Principles of Composition</td>
<td>9</td>
</tr>
<tr>
<td>Sp 211</td>
<td>Fundamentals of Speech</td>
<td>3</td>
</tr>
<tr>
<td>Communication Select from Engl 204, 205 Sp 336</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lib 106</td>
<td>Library Instruction</td>
<td>R</td>
</tr>
<tr>
<td>P E</td>
<td></td>
<td>6</td>
</tr>
<tr>
<td>ELECTIVES</td>
<td></td>
<td>15-17</td>
</tr>
</tbody>
</table>

* Opportunities for supervised teaching in home economics are offered in selected Iowa schools. Plans should be made with advisor 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**

- A A 103 Design I
- C D 270 The Individual and His Family I
- F & N 107 Nutrition and the Family's Food
- F & N 208 Foods I
- H Ec 105 Orientation to Home Economics
- H Ec 106 Careers in Home Economics
- H Ec 240 Introduction to Family Housing
- H Ec 400 Professional Relations
- H Ec 420A Senior Seminar
- H Mgt 375 Management in the Family
- H Eq. 254 Principles in Equipment
- T & C 104 Textiles

**Biological Sciences**

- Zool 155 Elementary Human Physiology and Anatomy

**Physical Sciences**

- Chem 105, 106 General Chemistry 6 Credits;
- or Chem 101, 102 General Chemistry 8 Credits
- Chem 231 Elementary Organic Chemistry 4 Credits

**Social Sciences**

- Econ 241, 242 Principles of Economics 6 Credits
- Govt 215 American Government 3 Credits
- Psych 101 General Psychology I 3 Credits
- Soc 134 Introduction to Sociology 3 Credits
- Soc 218 Introduction to Cultural Anthropology 3 Credits

**Written and Spoken English**

- Engl 101, 102, 103 Principles of Composition 9 Credits
- Sp 211 Fundamentals of Speech 3 Credits
- Lib 106 Library Instruction

**P E**

**Major in Consumer Economics**

Students interested in this major may pursue it either through Home Economics for General Education in the College of Home Economics or through the Department of Economics in the College of Science and Humanities. The major is designed for students interested in preparing for positions which require understandings of consumer behavior in our economy and of conditions which influence consumption in our society.

In addition to the Home Economics for General Education curriculum requirements, the following courses are to be completed.

**Home Economics**

- F & N 303 Family Meal Management 3 Credits
- H Mgt 415 Consumer Economics 3 Credits
- H Mgt 475 Home Management House 3 Credits
- H Mgt 488 Family Finance 3 Credits
- H Mgt 490B, C, D Special Problems 3 Credits
- H Mgt Select from
  - 520 Food Economics
  - 521 Social and Economic Aspects of Housing
  - 588 Family Economics

**Biological Sciences**

- Bact 304 General Bacteriology 5 Credits

**Physical Sciences**

- Math 104 Finite Mathematics 5 Credits
- Math 105 Mathematics in Western Culture or
- Math 101, 102 Algebra and Trigonometry I, II 4 Credits
- Stat 201 Principles of Statistics 5 Credits
- Phys 106 Elementary Physics 4 Credits
Social Sciences

Econ 307, 308 Prices & Resource Allocation 6 Credits
Econ 335 Agricultural Marketing 3 Credits
Econ 409 National Income and Employment 3 Credits
Econ 499B Special Problems 3 Credits
Hist 334, 335 Econ History of the U S 6 Credits
Ind Adm 340 Industrial Marketing 3 Credits
Psych 250 Psych of Sales & Advertising 3 Credits
Soc 464 Community Action 3 Credits
Philosophy Select from 3-4 Credits
260 Introduction to Philosophy
350 Introductory Logic

Written and Spoken English Select from 3 Credits
Engl 205 Propaganda Analysis
Engl 414A Writing of Reports and Technical Papers

T Jl 225 Publicity and Public Relations 3 Credits
Electives 30-34 Credits

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 33-34 Credits
A A 261 Interior House Design 3 Credits
C D 236 Principles of Child Development 3 Credits
H Mgt Select from 3-4 Credits
415 Consumer Economics 3 Credits
475 Home Management House 4 Credits
488 Family Finance 3 Credits
Additional Home Economics from at least three different areas 24 Credits

Biological Sciences 3-5 Credits
Bact 200 Introductory Bacteriology 3 Credits
Bact 304 General Bacteriology 5 Credits
Physical Sciences Biochem, Earth Science, Math, Phys, Stat 3-5 Credits
Social Sciences Econ, Hist, Govt, Psych, Soc 15 Credits
Humanites Hist, Phil, Lit, F L, Music 15 Credits
Electives 39-46 Credits

Major in Home Management

This major is designed for students interested in social welfare, extension service or business positions requiring a background in home management, family economics and social science.

In addition to the Home Economics for General Education curriculum requirements the following courses are to be completed.

Home Economics 22 Credits
F & N 303 Family Meal Management 3 Credits
H Mgt 415 Consumer Economics 3 Credits
H Mgt 475 Home Management House 4 Credits
H Mgt 488 Family Finance 3 Credits
H Mgt 490B, C, D Special Problems 3 Credits
Additional H Mgt 6 Credits

Biological Sciences 5 Credits
Bact 304 General Bacteriology 5 Credits

Physical Sciences 9 Credits
Math 104 Finite Mathematics 5 Credits
Phys 106 Elementary Physics 4 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), 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. Further information appears in the section International Service Programs.

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

<table>
<thead>
<tr>
<th>Major in International Service</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Home Economics</strong></td>
<td>31-36 Credits</td>
</tr>
<tr>
<td>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 &amp; N 302 Nutrition of the Child and the Family</td>
<td>3 Credits</td>
</tr>
<tr>
<td>F &amp; N 305 Nutrition and Dietetics</td>
<td>4 Credits</td>
</tr>
<tr>
<td>H Ec 440 B Field Trip</td>
<td>2 Credits</td>
</tr>
<tr>
<td>H Mgt Select from</td>
<td>3-4 Credits</td>
</tr>
<tr>
<td>415 Consumers Economics</td>
<td>3 Credits</td>
</tr>
<tr>
<td>475. Home Management House</td>
<td>4 Credits</td>
</tr>
<tr>
<td>488 Family Finance</td>
<td>3 Credits</td>
</tr>
<tr>
<td>520 Food Economics</td>
<td>3 Credits</td>
</tr>
<tr>
<td>Additional Home Economics</td>
<td>17-20 Credits</td>
</tr>
<tr>
<td>Physical Sciences</td>
<td>6 Credits</td>
</tr>
<tr>
<td>Geol 304 World Geography</td>
<td>3 Credits</td>
</tr>
<tr>
<td>Geol 305 Economic Geography</td>
<td>3 Credits</td>
</tr>
<tr>
<td>Social Sciences</td>
<td>18 Credits</td>
</tr>
<tr>
<td>Econ 334 Land Economics</td>
<td>3 Credits</td>
</tr>
<tr>
<td>Govt 241 Comparative Political Systems</td>
<td>3 Credits</td>
</tr>
<tr>
<td>Govt 351, 352 Politics of Developing Nations</td>
<td>6 Credits</td>
</tr>
<tr>
<td>Govt Select from</td>
<td>3 Credits</td>
</tr>
<tr>
<td>440 British and Commonwealth Governments</td>
<td></td>
</tr>
<tr>
<td>442 Governments of Eastern Asia</td>
<td></td>
</tr>
<tr>
<td>443 Latin American Governments</td>
<td></td>
</tr>
<tr>
<td>Soc 425 Intercultural Relations or</td>
<td></td>
</tr>
<tr>
<td>Soc 445 Population Problems and Policies</td>
<td>3 Credits</td>
</tr>
<tr>
<td>Humanities</td>
<td>31 Credits</td>
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<tr>
<td>Engl 201 Introduction to Literature</td>
<td>3 Credits</td>
</tr>
<tr>
<td>Engl 354 World Literature</td>
<td>3 Credits</td>
</tr>
<tr>
<td>F L one language</td>
<td>18 Credits</td>
</tr>
<tr>
<td>Hist Select from</td>
<td>3 Credits</td>
</tr>
<tr>
<td>323 History of the American Nations</td>
<td></td>
</tr>
<tr>
<td>370 The Far East in Modern Times</td>
<td></td>
</tr>
<tr>
<td>465 History of Latin America</td>
<td></td>
</tr>
<tr>
<td>480 Recent America</td>
<td></td>
</tr>
<tr>
<td>Phil 260 Introduction to Philosophy</td>
<td>4 Credits</td>
</tr>
</tbody>
</table>

**Electives** | 22-29 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 *The Iowa Homemaker*, 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.

### Home Economics

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>A A 103 Design I</td>
<td>4</td>
</tr>
<tr>
<td>A A 261 Interior House Design I</td>
<td>3</td>
</tr>
<tr>
<td>C D 236 Principles of Child Development</td>
<td>3</td>
</tr>
<tr>
<td>C D 270 The Individual and His Family I</td>
<td>4</td>
</tr>
<tr>
<td>F &amp; N 107 Nutrition and the Family's Food</td>
<td>4</td>
</tr>
<tr>
<td>H Ec 105 Orientation to Home Economics</td>
<td>1</td>
</tr>
<tr>
<td>H Ec 106 Careers in Home Economics</td>
<td>R</td>
</tr>
<tr>
<td>H Ec 240 Introduction to Family Housing</td>
<td>3</td>
</tr>
<tr>
<td>H Ec 400 Professional Relations</td>
<td>R</td>
</tr>
<tr>
<td>H Ec 4208 Senior Seminar</td>
<td>1</td>
</tr>
<tr>
<td>H Mgt 375 Management in the Family</td>
<td>4</td>
</tr>
<tr>
<td>H Mgt Additional Home Management</td>
<td>3</td>
</tr>
<tr>
<td>T &amp; C 104 Textiles</td>
<td>3</td>
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</tbody>
</table>

Home Economics (Concentration of a minimum of 18 credits in one area, may include required courses in that area) 11-15 credits

### Technical Journalism

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
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<tbody>
<tr>
<td>101 Introduction to Mass Communication Fr</td>
<td>2</td>
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<tr>
<td>Group A: 2 but no more than 4 courses</td>
<td>7-8</td>
</tr>
<tr>
<td>221, 222, 252, 325, 341</td>
<td></td>
</tr>
<tr>
<td>Group B: 2 but no more than 4 courses</td>
<td>6-7</td>
</tr>
<tr>
<td>Group C: at least 3 courses</td>
<td>6-8</td>
</tr>
<tr>
<td>417, 430, 431, 462, 463, 464</td>
<td></td>
</tr>
</tbody>
</table>

### Biological Sciences

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>Zoal 155 Elementary Human Physiology and Anatomy</td>
<td>5</td>
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<tr>
<td>Bact 200 or 304</td>
<td>3-5</td>
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</table>

### Physical Sciences

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

### Social Sciences

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>Econ 241, 242 Principles of Economics</td>
<td>6</td>
</tr>
<tr>
<td>Govt 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>
<td>3</td>
</tr>
<tr>
<td>Soc 218 Introduction to Cultural Anthropology</td>
<td>3</td>
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</tbody>
</table>

### Humanities

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>Hist, Phil, Lit, F L</td>
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### Written and Spoken English

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>Engl 101, 102, 103 Principles of Composition</td>
<td>9</td>
</tr>
<tr>
<td>Sp 211 Fundamentals of Speech</td>
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### Lib 106 Library Instruction

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
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### Electives

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>R</td>
<td>41</td>
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</tbody>
</table>

In addition to the 198 credits required for graduation, all students must fulfill the: 490J, professional work requirement involves three months full-time work, or equivalent, in professional mass communication 6 cr.

### Curriculum in Household Equipment

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

A A 103 Design I
C D 270 The Individual and His Family I
F & N 107 Nutrition and the Family's Food
F & N 214 Foods I
F & N 303 Family Meal Management
H Ec 105 Orientation to Home Economics
H Ec 106. Careers in Home Economics
H Ec 400 Professional Relations
H Mgt 375 Management in the Family
H Mgt Select from
  415 Consumer Economics 3 Credits
  475 Home Management House 4 Credits
  488 Family Housing 3 Credits
H Eq 254 Principles of Equipment 3 Credits
H Eq 308 Home Lighting and Kitchen Planning 4 Credits
H Eq 318 Small Equipment 3 Credits
H Eq 400 Senior Observation Trip R
H Eq 407 Gas and Electric Ranges 3 Credits
H Eq 408. Home Laundering Technology 4 Credits
H Eq 409. Home Refrigeration 3 Credits
H Eq 421 Training in Demonstration Techniques 3 Credits
H Eq 422 Professional Orientation 3 Credits
H Eq 425 Seminar 2 Credits
H Eq 445 House Utilities or
H Eq 446 House Evaluation 3 Credits
T & C 104 Textiles I 3 Credits
Select from
  A Arch 334 or 335 Residential Architecture 3 Credits
  B F & N 411 Experimental Studies of Food 4 Credits
  C T & C 304 Intermediate Textiles 3 Credits

Biological Sciences
Bact, Biochem, Bot, Gen, Zool
Zool 155 Elementary Human Physiology and Anatomy 5 Credits

Physical Sciences
Chem 105, 106 or 101, 102 General Chemistry 6 Credits
Chem 231 Elementary Organic Chemistry 4 Credits
Math 101 Algebra and Trigonometry I 5 Credits
Phys 106 Elementary Physics 4 Credits

Social Sciences
Econ 241, 242 Principles of Economics 6 Credits
Govt 215 American Government 3 Credits
Psych 101 General Psychology I 3 Credits
Psych 250 Psychology of Sales and Advertising 3 Credits
Soc 134 Introduction to Sociology 3 Credits
Soc 218 Introduction to Cultural Anthropology 3 Credits

Humanities
Hist, Phil, Lit, F L, Music

Written and Spoken English
Engl 101, 102, 103 Principles of Composition 9 Credits
Engl 414 Writing of Scientific Papers 3 Credits
Sp 211 Fundamentals of Speech 3 Credits
Sp 302 Television and Radio Speech 3 Credits
T J 225 Publicity and Public Relations 3 Credits
Lib 106 Library Instruction R

P E
6 Credits

Electives 40-44 Credits

For students who are interested in testing and development or going into graduate work in equipment, the following courses are recommended: Math 102, Stat 201

Major in Household Equipment and Related Science

A major area of study for students interested in sciences, mathematics and/or graduate work.

HOME ECONOMICS
F & N 107 Nutrition and the Family's Food 4 Credits
F & N 214 Foods I 4 Credits
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>H. Ec 105</td>
<td>Orientation to Home Economics</td>
<td>1</td>
</tr>
<tr>
<td>H. Ec 106</td>
<td>Careers in Home Economics</td>
<td>R</td>
</tr>
<tr>
<td>H. Ec 400</td>
<td>Professional Relations</td>
<td>R</td>
</tr>
<tr>
<td>H. Eq 254</td>
<td>Principles in Equipment</td>
<td>3</td>
</tr>
<tr>
<td>H. Eq 404</td>
<td>Equipment Technology</td>
<td>4</td>
</tr>
<tr>
<td>H. Eq 407</td>
<td>Gas and Electric Ranges</td>
<td>3</td>
</tr>
<tr>
<td>H. Eq 408</td>
<td>Home Laundering Technology</td>
<td>4</td>
</tr>
<tr>
<td>H. Eq 409</td>
<td>Home Refrigeration</td>
<td>3</td>
</tr>
<tr>
<td>H. Eq 490</td>
<td>Special Problems</td>
<td>6</td>
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<tr>
<td>Lighting</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>Additional</td>
<td></td>
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</tr>
<tr>
<td>425 Seminar</td>
<td></td>
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<tr>
<td>T &amp; C 104</td>
<td>Textiles</td>
<td>3</td>
</tr>
<tr>
<td>Group I</td>
<td></td>
<td>7</td>
</tr>
<tr>
<td>F &amp; N 215</td>
<td>Foods II</td>
<td>3</td>
</tr>
<tr>
<td>and</td>
<td></td>
<td></td>
</tr>
<tr>
<td>F &amp; N 411</td>
<td>Experimental Studies of Food</td>
<td>4</td>
</tr>
<tr>
<td>or</td>
<td></td>
<td></td>
</tr>
<tr>
<td>T &amp; C 304</td>
<td>Intermediate Textiles</td>
<td>3</td>
</tr>
<tr>
<td>and</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chem 466</td>
<td>Textile Chemistry</td>
<td>4</td>
</tr>
<tr>
<td>Group II</td>
<td></td>
<td>15</td>
</tr>
<tr>
<td>Home economics courses in addition to major area and home economics courses listed</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Biological Sciences</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Bact 304</td>
<td>General Bacteriology</td>
<td></td>
</tr>
<tr>
<td>Physical Sciences</td>
<td>54-56</td>
<td></td>
</tr>
<tr>
<td>Chem 101, 102 or 105, 106 General Chemistry</td>
<td>6-8</td>
<td></td>
</tr>
<tr>
<td>Chem 103</td>
<td>Systematic Inorganic Chemistry</td>
<td>4</td>
</tr>
<tr>
<td>Chem 231</td>
<td>Elementary Organic Chemistry</td>
<td>5</td>
</tr>
<tr>
<td>Math 101</td>
<td>Algebra and Trigonometry I</td>
<td>5</td>
</tr>
<tr>
<td>Math 102</td>
<td>Algebra and Trigonometry II</td>
<td>5</td>
</tr>
<tr>
<td>Math 110</td>
<td>Analytic Geometry and Calculus I</td>
<td>5</td>
</tr>
<tr>
<td>Math 211</td>
<td>Analytic Geometry and Calculus II</td>
<td>4</td>
</tr>
<tr>
<td>Phys 111, 112, 113 General Physics</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>Phys or Chem Electives</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Stat 201</td>
<td>Principles of Statistics</td>
<td>5</td>
</tr>
<tr>
<td>Social Sciences</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Govt 215</td>
<td>American Government</td>
<td>3</td>
</tr>
<tr>
<td>Additional</td>
<td></td>
<td>12</td>
</tr>
<tr>
<td>Written and Spoken English</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Engl 101, 102, 103 Principles of Composition</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>Engl 414</td>
<td>Writing of Scientific Papers</td>
<td>3</td>
</tr>
<tr>
<td>Sp 211</td>
<td>Fundamentals of Speech</td>
<td>3</td>
</tr>
<tr>
<td>Lib 106</td>
<td>Library Instruction</td>
<td>R</td>
</tr>
<tr>
<td>Foreign languages F L 201, 202 French or</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>F L 231, 232 German or</td>
<td></td>
<td></td>
</tr>
<tr>
<td>F L 221A, 222A Russian</td>
<td></td>
<td></td>
</tr>
<tr>
<td>P E</td>
<td></td>
<td>6</td>
</tr>
<tr>
<td>1 JI 225</td>
<td>Publicity and Public Relations</td>
<td>3</td>
</tr>
<tr>
<td>Electives</td>
<td></td>
<td>33-35</td>
</tr>
</tbody>
</table>

**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, H. Ec. 105 and H. Mgt. 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 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.
The following courses, totaling 152-154 credits, are required for each degree student in Institution Management. Additional courses for each specific major will follow.

### Home Economics

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>A A 103 Design I</td>
<td>4</td>
</tr>
<tr>
<td>C D 270 The Individual and His Family I</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. 214 Foods I</td>
<td>4</td>
</tr>
<tr>
<td>F &amp; N. 215, Foods II</td>
<td>4</td>
</tr>
<tr>
<td>F &amp; N. 303 Family Meal Management</td>
<td>3</td>
</tr>
<tr>
<td>H Ec 105 Orientation to Home Economics</td>
<td>1</td>
</tr>
<tr>
<td>H Ec. 106. Careers in Home Economics</td>
<td>R</td>
</tr>
<tr>
<td>H Ec. 400 Professional Relations</td>
<td>R</td>
</tr>
<tr>
<td>H Mgt. 375. Management in the Family</td>
<td>4</td>
</tr>
<tr>
<td>H.Eq. 254. Principles in Equipment</td>
<td>3</td>
</tr>
<tr>
<td>I Mgt 287 Introduction to Food Service Management</td>
<td>2</td>
</tr>
<tr>
<td>I Mgt 380 Quantity Food Production Management</td>
<td>4</td>
</tr>
<tr>
<td>I Mgt 400 Study Tour</td>
<td>1</td>
</tr>
<tr>
<td>I, Mgt 404 Seminar</td>
<td>2</td>
</tr>
<tr>
<td>I Mgt 484 Purchasing .</td>
<td>4</td>
</tr>
<tr>
<td>I, Mgt 485 Equipment</td>
<td>4</td>
</tr>
<tr>
<td>I Mgt 487 Organization and Management</td>
<td>3</td>
</tr>
<tr>
<td>I Mgt. 488, Personnel Management in Institutions</td>
<td>3</td>
</tr>
<tr>
<td>I, Mgt. Selection</td>
<td>3</td>
</tr>
<tr>
<td>T &amp; C. 104. Textiles</td>
<td>3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Concentration A</th>
<th>14 Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>B. &amp; B 301. Biochemistry</td>
<td>3 Credits</td>
</tr>
<tr>
<td>Ed. 305A Methods of Teaching</td>
<td>3 Credits</td>
</tr>
<tr>
<td>F &amp; N 305. Nutrition and Dietetics</td>
<td>4 Credits</td>
</tr>
<tr>
<td>F &amp; N 411 Experimental Studies of Food</td>
<td>4 Credits</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Concentration B</th>
<th>12 Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Econ 305 Labor Economics and Labor Relations</td>
<td>3 Credits</td>
</tr>
<tr>
<td>I Ad. 365D Business Law I</td>
<td>3 Credits</td>
</tr>
<tr>
<td>I Ad. 385 Accounting II</td>
<td>3 Credits</td>
</tr>
<tr>
<td>I Mgt Selection</td>
<td>3 Credits</td>
</tr>
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</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>15 Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chem 105, 106 or 101, 102 General Chemistry</td>
<td>6-8 Credits</td>
</tr>
<tr>
<td>Chem 231 Elementary Organic Chemistry</td>
<td>4.5 Credits</td>
</tr>
<tr>
<td>Select from Biochem, Chem, Earth Science, Math, Phys</td>
<td>2.5 Credits</td>
</tr>
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</table>

<table>
<thead>
<tr>
<th>Social Sciences</th>
<th>18 Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Econ 241, 242 Principles of Economics</td>
<td>6 Credits</td>
</tr>
<tr>
<td>Govt 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>
<tr>
<td>Soc 218 Introduction to Cultural Anthropology</td>
<td>3 Credits</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Humanities Hist., Phil., Lit., F. L., Music</th>
<th>15 Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Written and Spoken English</td>
<td>12 Credits</td>
</tr>
<tr>
<td>Eng1. 101, 102, 103, Principles of Composition</td>
<td>9 Credits</td>
</tr>
<tr>
<td>Sp. 211 Fundamentals of Speech</td>
<td>3 Credits</td>
</tr>
<tr>
<td>I Ad. 384 Accounting I</td>
<td>4 Credits</td>
</tr>
<tr>
<td>Lib 106 Library Instruction</td>
<td>R</td>
</tr>
<tr>
<td>P E</td>
<td>6 Credits</td>
</tr>
</tbody>
</table>

### Major in College Food and Housing Administration

In addition to the curriculum requirements the following courses are to be completed.

<table>
<thead>
<tr>
<th>Home Economics</th>
<th>8 Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>I. Mgt. 486A. Institution Management Experience</td>
<td>2 Credits</td>
</tr>
<tr>
<td>I. Mgt. 486B Institution Management Experience</td>
<td>3 Credits</td>
</tr>
<tr>
<td>I Mgt 489, House Administration</td>
<td>3 Credits</td>
</tr>
<tr>
<td>I. E 475 Motion and Time Study</td>
<td>3 Credits</td>
</tr>
<tr>
<td>I. E Selection</td>
<td>3 Credits</td>
</tr>
</tbody>
</table>

| Electives                                                           | 30-32 Credits |

Major in Restaurant Management

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

Home Economics 5 Credits
1 Mgt 486A Institution Management Experience 2 Credits
1 Mgt 486B Institution Management Experience 3 Credits
Electives 39.41 Credits

Major in School Food Service

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

Home Economics 6 Credits
F & N 410 Nutrition During Human Growth and Development 3 Credits
1 Mgt 486A Institution Management Experience 1 Credit
1 Mgt 486B Institution Management Experience 2 Credits
Ed 204 Foundations of American Education 3 Credits
Electives 35-37 Credits

Technical Institute in Food Service Management

For the outline of courses for the two-year Technical Institute in Food Service Management, see Technical Institute. The graduate is awarded an Associate Degree 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 Science and Humanities for Group Requirements leading to a degree through the College of Science 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 13 Credits
190 Introduction to Physical Education 3 Credits
265 Fundamentals of Modern Dance 1 Credit
452 Evaluation in Physical Education 4 Credits
480 Scientific Bases of Physical Education 5 Credits

Health Education 11 Credits
F & N 107 Nutrition and the Family's Food 4 Credits
Hyg 104A B Health Education 4 Credits
Hyg 304 School Health Problems 3 Credits

Professional Education 30 Credits
Ed 204 Foundations of American Education 3 Credits
Ed 305 Methods of Teaching 4 Credits
Ed 426 Principles of Secondary Education 3 Credits
P E W 385 Techniques and Methods of Social Folk and Square Dance 2 Credits
P E W 417 Supervised Teaching in Physical Education 9 Credits
P E W 470 Elementary School Physical Education 2 Credits
P E W 471 Elementary School Physical Education Teaching Methods 1 Credit
Psych 230 Developmental Psychology 3 Credits
Psych 333 Educational Psychology 3 Credits

Biological Sciences 10 Credits
Zool 155 Elementary Physiology and Anatomy 5 Credits
Zool 359 Kinesiology 5 Credits

Physical Sciences 4 Credits
Physics 106 Elementary Physics 4 Credits

Social Sciences 15 Credits
Econ 241 Principles of Economics 3 Credits
Govt 215 American Government 3 Credits
Psych 101 General Psychology I 3 Credits
Psych 430 Psychology of Adolescence 3 Credits
Soc 134 Introduction to Sociology 3 Credits

Humanities . . .

History .
Engl 201 Introduction to Literature 6 Credits
Music 354 Music Appreciation 3 Credits
A A 384 Survey of Art 2 Credits
Lib 106 Library Instruction 3 Credits
P E
Written and Spoken English
Engl 101, 102, 103 Principles of Composition 9 Credits
Sp 211 Fundamentals of Speech 3 Credits

Concentrations . . .

11 Credits

*Students 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.

Major in Physical Education for Women

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

P E 150, 151, 152 Fundamentals of Physical Education Activities 3 Credits
P E 250, 251, 252 Fundamentals of Physical Education Activities 3 Credits
P E 270, 271 Officiating 4 Credits
P E 390, 391, 392 Educational Bases of Physical Education 18 Credits

Biological Sciences
Zool 102 The Animal Kingdom 5 Credits

Physical Sciences
Chem 105, 106 or 101, 102 or 101A, 102A General Chemistry 8 Credits

Social Sciences
Econ 242 Principles of Economics 3 Credits
Soc 364 Group Dynamics 3 Credits

Written and Spoken English Select from
Engl 204 Intermediate Composition
Engl 205 Propaganda Analysis
Engl 304 Advanced Composition
Engl 414A Writing of Reports and Technical Papers

Electives 21-23 Credits

The state requirement of a minimum of 30 credits to qualify to teach physical education half time or less can be met by completing P E W 150, 151, 152, 190, 250, 251, 252, 265, 385, 390, 391, 392

Major in Physical Education—Dance Option

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

P E 150, 151, 152, 250, 251, 252 Fundamentals of Physical Education Activities Select 3 courses 3 Credits
P E 210, 211, 212 Composition, Concert Dance, Techniques 1 or each 3 Credits
P E 310, 311 Dance Production 2 Credits
P E 380 History and Philosophy of Dance 3 Credits
P E 386 Methods of Teaching Modern Dance 3 Credits
P E 390, 391, 392 Educational Bases of Physical Education 10-12 Credits
P E 490D Special Topics in Dance 1-4 Credits

Physical Sciences
A A 103 Design I 6 Credits

Humanities
Communicative Arts

Electives 22-27 Credits

Any student with a teaching major in another area can qualify to teach dance activities half time or less by completing P E W 117, 118, 265, 210, 211, 212, 310, 311, 380, 385, 386, 470A, 472, Music 354, A A 384, Zool 155

Certification to Teach Physical Education in Elementary Schools

In addition to the requirements of the major program leading to secondary school certification, students desiring to receive kindergarten through twelfth grade certification in physical education must complete the following courses:
### Curriculum in Textiles and Clothing

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

Five majors are offered in the Textiles and Clothing Department: Merchandising, Clothing, Textiles, Textile and Clothing Design, and Textiles and Related Science.

#### 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>A A 384</td>
<td>Survey of Art</td>
<td>3</td>
</tr>
<tr>
<td>C D 270</td>
<td>The Individual and His Family I</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 Ec 105</td>
<td>Orientation to Home Economics</td>
<td>1</td>
</tr>
<tr>
<td>H Ec 106</td>
<td>Careers in Home Economics</td>
<td>R</td>
</tr>
<tr>
<td>H Ec 400</td>
<td>Professional Relations</td>
<td>R</td>
</tr>
<tr>
<td>H Mgt 375</td>
<td>Management in the Family</td>
<td>4</td>
</tr>
<tr>
<td>T &amp; C 104</td>
<td>Textiles</td>
<td>3</td>
</tr>
<tr>
<td>T &amp; C 123 or 125</td>
<td>Pattern Making and Clothing Construction</td>
<td>4-5</td>
</tr>
<tr>
<td>T &amp; C 245</td>
<td>Clothing Selection</td>
<td>3</td>
</tr>
<tr>
<td>T &amp; C 304</td>
<td>Intermediate Textiles</td>
<td>3</td>
</tr>
<tr>
<td>T &amp; C 365</td>
<td>Professional Opportunities in Textiles and Clothing</td>
<td>3</td>
</tr>
<tr>
<td>T &amp; C 401</td>
<td>Senior Study Tour</td>
<td>1</td>
</tr>
<tr>
<td>T &amp; C 410</td>
<td>Textiles and Clothing Department Seminar</td>
<td>R</td>
</tr>
<tr>
<td>T &amp; C 414</td>
<td>Historic Textiles</td>
<td>3</td>
</tr>
<tr>
<td>T &amp; C 464</td>
<td>Family Clothing Consumption</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 155</td>
<td>Elementary Human Physiology and Anatomy</td>
<td>5</td>
</tr>
</tbody>
</table>

#### Humanities

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hist 205, 206</td>
<td>Introduction to Western Civilization</td>
<td>6</td>
</tr>
</tbody>
</table>

#### Physical Sciences

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chem 105, 106 or 101, 102</td>
<td>General Chemistry</td>
<td>6-8</td>
</tr>
<tr>
<td>Chem 231</td>
<td>Elementary Organic Chemistry</td>
<td>4</td>
</tr>
</tbody>
</table>

#### Social Sciences

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Econ 241, 242</td>
<td>Principles of Economics</td>
<td>6</td>
</tr>
<tr>
<td>Govt 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>
<tr>
<td>Soc 218</td>
<td>Introduction to Cultural Anthropology</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 101, 102, 103</td>
<td>Principles of Composition</td>
<td>9</td>
</tr>
<tr>
<td>Sp 211</td>
<td>Fundamentals of Speech</td>
<td>3</td>
</tr>
<tr>
<td>Lib 106</td>
<td>Library Instruction</td>
<td>R</td>
</tr>
<tr>
<td>P E</td>
<td></td>
<td>6</td>
</tr>
</tbody>
</table>

#### Major in Merchandising

This major prepares the student for work in merchandising; supervised work experience in a department store may be arranged.

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

#### Home Economics

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>A A 213</td>
<td>Fashion Illustration I</td>
<td>3</td>
</tr>
<tr>
<td>A A 150</td>
<td>Drawing I</td>
<td>3</td>
</tr>
<tr>
<td>A A 261</td>
<td>Interior House Design I</td>
<td>3</td>
</tr>
</tbody>
</table>

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*These take the place of 471 listed in the major program.

Provision for teaching in an elementary as well as a secondary program will be made in P E 417, Supervised Teaching of Physical Education.
H. Mgt. 415. Consumer Economics
or
Econ. 305. Labor Economics and Labor Relations 3 Credits
T & C. 225. Draping and Clothing Construction 3 Credits
T & C. 345. Costume Design and Selection 3 Credits
T & C. 404. Advanced Textiles 3 Credits
T & C. 454. History of Costume 3 Credits

Biological Sciences: Bact., Biochem., Bot., Gen., Zool. 3 Credits
Social Sciences
Econ. 466. Retailing 3 Credits
Psych. 250. Psychology of Sales and Advertising 3 Credits
Soc. 380. Social Relations in Industry 3 Credits
I. Ad. 365D. Business Law I 3 Credits
I. Ad. 384. Accounting I 4 Credits
T. Jl. 225. Publicity and Public Relations 3 Credits
or
T. Jl. 325. Technical Advertising 3 Credits
Electives 36-41 Credits

Major in Clothing
This major is planned for students interested in teaching (in stores, home or extension), custom dress making, or working with pattern companies.
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>Home Economics</td>
<td>30-31</td>
</tr>
<tr>
<td>A.A. 150. Drawing I</td>
<td>3</td>
</tr>
<tr>
<td>A.A. 213. Fashion Illustration I</td>
<td>3</td>
</tr>
<tr>
<td>A.A. 261. Interior House Design I (3 Credits)</td>
<td>3</td>
</tr>
<tr>
<td>or</td>
<td></td>
</tr>
<tr>
<td>A. A. 335. Textile Design I (4 Credits)</td>
<td>3.4</td>
</tr>
<tr>
<td>H.Eq. 254. Principles in Equipment</td>
<td>.3</td>
</tr>
<tr>
<td>T &amp; C. 225. Draping and Clothing Construction</td>
<td>.3</td>
</tr>
<tr>
<td>T &amp; C. 326. Children's Clothing</td>
<td>.3</td>
</tr>
<tr>
<td>T &amp; C. 345. Costume Design and Selection</td>
<td>.3</td>
</tr>
<tr>
<td>T &amp; C. 404. Advanced Textiles</td>
<td>.3</td>
</tr>
<tr>
<td>T &amp; C. 454. History of Costume</td>
<td>.3</td>
</tr>
<tr>
<td>Additional Clothing Construction</td>
<td>.3</td>
</tr>
<tr>
<td>Biological Sciences: Bact., Biochem., Bot., Gen., Zool</td>
<td></td>
</tr>
<tr>
<td>Electives</td>
<td>36-41</td>
</tr>
</tbody>
</table>

Major in Textiles
This major prepares the student for work in quality control laboratories or as a consultant for promotional work in textiles.
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>Home Economics</td>
<td>16</td>
</tr>
<tr>
<td>A.A. 344. Weaving</td>
<td>3</td>
</tr>
<tr>
<td>H.Eq. 254. Principles in Equipment</td>
<td>.3</td>
</tr>
<tr>
<td>H. Eq. 408. Home Laundering Technology</td>
<td>.4</td>
</tr>
<tr>
<td>T &amp; C. 404. Advanced Textiles</td>
<td>.3</td>
</tr>
<tr>
<td>T &amp; C. 490A. Special Problem in Textiles</td>
<td>5</td>
</tr>
<tr>
<td>Biological Sciences</td>
<td></td>
</tr>
<tr>
<td>Bact. 304. General Bacteriology</td>
<td>5</td>
</tr>
<tr>
<td>Physical Sciences</td>
<td>20</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. 466. Textile Chemistry</td>
<td>.4</td>
</tr>
<tr>
<td>Math.</td>
<td></td>
</tr>
<tr>
<td>Phys. 106. Elementary Physics</td>
<td>4</td>
</tr>
<tr>
<td>Written and Spoken English</td>
<td>.3</td>
</tr>
<tr>
<td>Engl. 414A Technical Research and Business Report Writing</td>
<td>.5</td>
</tr>
<tr>
<td>Stat. 201. Principles of Statistics</td>
<td></td>
</tr>
<tr>
<td>Electives</td>
<td>37-40</td>
</tr>
</tbody>
</table>
## Major in Textile and Clothing Design

This major is planned for students interested in designing. In addition to the curriculum requirements the following courses are to be completed:

<table>
<thead>
<tr>
<th>Home Economics</th>
<th>33-35 Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>A A 150 Drawing I</td>
<td>3 Credits</td>
</tr>
<tr>
<td>A A 213 Fashion Illustration I</td>
<td>3 Credits</td>
</tr>
<tr>
<td>A A 344 Craft Design I</td>
<td>3 Credits</td>
</tr>
<tr>
<td>A A 335 Textile Design I</td>
<td>4 Credits</td>
</tr>
<tr>
<td>A A 485 Medieval, Renaissance and Oriental Art</td>
<td>3 Credits</td>
</tr>
<tr>
<td>A A 486 Modern Art</td>
<td>3 Credits</td>
</tr>
<tr>
<td>T &amp; C 225 Draping and Clothing Construction</td>
<td>3 Credits</td>
</tr>
<tr>
<td>T &amp; C 326 Children’s Clothing</td>
<td>3 Credits</td>
</tr>
<tr>
<td>T &amp; C 345 Costume Design and Selection</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 490D Special Problem in Design</td>
<td>2.4 Credits</td>
</tr>
</tbody>
</table>

### Biological Sciences

- Bact, Biochem, Bot, Zool: 3 Credits
- Physical Sciences: Biochem, Chem, Earth Science, Math, Phys, Stat: 2.4 Credits

### Electives

- 44-51 Credits

## Major in Textiles and Related Science

This major is for the student who is interested in textiles research or graduate study.

<table>
<thead>
<tr>
<th>Home Economics</th>
<th>40-41 Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>A A 103 Design I</td>
<td>4 Credits</td>
</tr>
<tr>
<td>C D 270 The Individual and His Family I</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 105 Orientation to Home Economics</td>
<td>1 Credit</td>
</tr>
<tr>
<td>H Ec 106 Careers in Home Economics</td>
<td>R</td>
</tr>
<tr>
<td>H Ec 400 Professional Relations</td>
<td>R</td>
</tr>
<tr>
<td>H Mgt 375 Management in the Family</td>
<td>4 Credits</td>
</tr>
<tr>
<td>H Eq 254 Principles in Equipment</td>
<td>3 Credits</td>
</tr>
<tr>
<td>T &amp; C 104 Textiles</td>
<td>3 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 245 Clothing Selection</td>
<td>3 Credits</td>
</tr>
<tr>
<td>T &amp; C 304 Intermediate Textiles</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 404 Advanced Textiles</td>
<td>3 Credits</td>
</tr>
<tr>
<td>T &amp; C 410 Textiles and Clothing Department Seminar</td>
<td>1 Credit</td>
</tr>
<tr>
<td>T &amp; C 414 Historic Textiles</td>
<td></td>
</tr>
<tr>
<td>T &amp; C 454 History of Costume</td>
<td>3 Credits</td>
</tr>
</tbody>
</table>

### Biological Sciences

- Bact: 304 General Bacteriology: 5 Credits
- Zool: 101 and 102 General Zoology: 8 Credits
- or Zool: 155 Elementary Human Physiology and Anatomy: 5 Credits

### Physical Sciences

- Chem: 101, 102 or 105, 106 General Chemistry: 6-8 Credits
- Chem: 103 Systematic Inorganic Chemistry: 4 Credits
- Chem: 211 Quantitative Analysis: 5 Credits
- Chem: 334, 335 Organic Chemistry: 6 Credits
- Chem: 466 Textile Chemistry: 4 Credits
- Math: 101 Algebra and Trigonometry I: 5 Credits
- Math: 102 Algebra and Trigonometry II: 5 Credits
- Math: 110 Analytic Geometry and Calculus I: 5 Credits
- Math: 211 Analytic Geometry and Calculus II: 5 Credits
- Phys: 111, 112 General Physics: 8 Credits

### Social Sciences

- Econ: 241, 242 Principles of Economics: 6 Credits
- Govt: 215 American Government: 3 Credits
- Hist: 205, 206 Introduction to Western Civilization: 6 Credits
- Psych: 101 General Psychology: 3 Credits
- Soc: 134 Introduction to Sociology: 3 Credits
- Soc: 218 Introduction to Cultural Anthropology: 3 Credits

### Written and Spoken English

- 15 Credits
<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engl. 101, 102, 103. Principles of Composition</td>
<td>9</td>
</tr>
<tr>
<td>Sp. 211. Fundamentals of Speech</td>
<td>3</td>
</tr>
<tr>
<td>Lib. 106. Library Instruction</td>
<td></td>
</tr>
<tr>
<td>F. L. 201, 202. (French) or 231, 232. (German) or 221A, 222A. (Russian)</td>
<td>6</td>
</tr>
<tr>
<td>P. E.</td>
<td>6</td>
</tr>
<tr>
<td>Electives</td>
<td>38-44</td>
</tr>
</tbody>
</table>
College of Sciences and Humanities

The complexities of modern life can no longer be appreciated or faced intelligently without the basic knowledge provided by education in the sciences and the humanities. The activities of agriculture, commerce, government, industry and medicine depend more and more on the development and communication of ideas and values provided by those prepared in the mathematical, physical, biological and social sciences and in history, language, literature and philosophy. Opportunities for careers as scientists, technicians, managers, writers and teachers thus arise in laboratories, offices and classrooms under diverse sponsorship and for manifold purposes.

Curriculum in Sciences and Humanities

Leading to the degree Bachelor of Science.

Group Requirements

As a prerequisite to graduation, to insure breadth of educational experience, and to provide a foundation for later work in a major field, each student must complete, some time during the four years, credits in the basic areas of learning specified below. A minimum total of 105 credits must be distributed in the seven groups. Wherever the semicolon appears in this list, it means "and/or."

I. Written and Spoken English Engl. 101, 102, 103, Sp 211, Engl 205; 304, 414 15-21
II. Mathematics; Statistics; Computer Science. 15-21
III. Chemistry; Physics; Earth Science; Biochemistry; Biophysics. 9-21
IV. Botany; Zoology; Bacteriology; Genetics. 9-21
V. Economics; Sociology; Psychology; Government; Industrial Administration (except courses in accounting) Govt 215 is required of all students 9-21
VI. History; Literature; Philosophy. 9-21
VII. Foreign languages. At least 9 credits in one language. 9-21

General Requirements

Degree programs must be approved by the department of the major (see list of majors below) and by the Dean of the College of Sciences and Humanities. All candidates for a degree in the College of Sciences and Humanities are expected to achieve a passing grade in every course pursued in this College. Each degree program will contain:

(1) At least 198 credits, including the basic group requirements described above, the major, two minors, and electives (which may include ROTC). To these must be added six quarters of physical education and a course in library science.

(2) One major, minimum of 30 credits, and two minors, totaling at least 30 credits, related to each student's basic educational objectives. See, however, the Distributed Studies Program, described below, which requires essentially four minors totaling 60 credits. Credits applied to the basic group requirements may not be counted toward the major or the minors. Student programs may contain a number of elective credits beyond the basic group requirements and the major and minors. The student will plan a program as follows:
Freshman Year

During this year, the student must complete 9 credits in written English (Group 1) and at least 10 credits in the mathematical sciences (Group 2). In addition, 24 to 27 credits will be chosen from courses offered by departments in Groups 3, 4, or 5, with more than one group represented. Students in Naval Science may postpone completion of group requirements equivalent in credits to the required work in Naval Science.

Sophomore Year

If only four of the seven groups were represented in the freshman year, the sophomore program must include courses in a fifth group (minimum of 3 credits). During the sophomore year the student may experiment further with the basic fields of learning, in order to discover aptitude and interest, or may elect courses in a field already chosen, including related work suggested by the major department. Normally, the student should know by the third quarter of the sophomore year what his major will be.

Junior and Senior Years

(1) The completion of whatever group requirements remain after the freshman and sophomore years.
(2) The completion of the major and two minors (defined under General Requirements).
(3) Elective courses.
Each student must work out a complete program of courses for the junior and senior
years in conference with the head of the major department or his representative.

A major consisting of at least 30 credits may be chosen from the following list. See Index for page references.

- Bacteriology
- Biochemistry
- Biophysics
- Botany
- Chemistry
- Computer Science
- Earth Science
- Economics
- English
- Foreign Languages
- Genetics
- Government
- History
- Industrial Administration
- Mathematics
- Metallurgy
- Music
- Naval Science
- Philosophy
- Physical Education for Men
- Physical Education for Women
- Physics
- Psychology
- Sociology
- Speech
- Statistics
- Science Journalism
- Zoology

The two minors, totaling 30 credits, should be related to the student’s basic educational objectives and should be composed of courses ordinarily of senior college rank. These minors may be chosen from the list of fields which appears above, and from the following: Air Science, Climatology and Meteorology, Military Science, Telecommunicative Arts, or fields in other colleges. If justified by the student’s vocational objective, a minor may include closely related courses offered by more than one department.

Distributed Studies Program in the Sciences and Humanities

For opportunities in Distributed Studies, see Index.

Degree programs in Distributed Studies must include the following:

1. Courses to fulfill the group requirements as described under Curriculum in Sciences and Humanities above. Courses selected to meet group requirements should also provide prerequisites for courses to be used in (2) and (3) below.

2. Concentrations in four related fields of study, each field to consist of from 9 to 21 credits, all totaling 60 credits. Courses acceptable in the field concentrations must be based on a prerequisite of three or more courses. Fields may be those of departments either within or outside the College of Sciences and Humanities, as well as certain non-departmentalized areas of instruction.

3. Electives chosen only from courses numbered 300 or above, except with permission of the Dean.

Preparation for the Study of Law

Preparation may be made for the study of law by the satisfactory completion of three years of study under the curriculum in Sciences and Humanities. If followed by transfer of suitable credits from later study at a recognized law college, Iowa State University will grant the degree Bachelor of Science. The program at Iowa State should be planned not later than the sophomore year and must be approved by the department concerned and by the Dean. Students commonly use majors in Economics, Sociology, English, Speech, History, Government, Industrial Administration, Psychology or Distributed Studies to prepare for the study of law.

Preparation for the Study of Medicine

Students preparing for the regular curriculum in Veterinary Medicine may take the preliminary years in the College of Sciences and Humanities, as outlined in the preceding pages, with modifications suggested by the student’s adviser. Students in Veterinary Medi-
cine who wish to receive both the degrees Doctor of Veterinary Medicine and Bachelor of Science will take at least three years' work in the curriculum in Sciences and Humanities. Such a program must have the approval of the Dean of Sciences and Humanities and the Dean of Veterinary Medicine.

Students preparing for the study of human medicine or medical technology will take at least the work of the first three or four years of the curriculum in Sciences and Humanities. The general outline, as described in the preceding pages, will be followed with modifications in terms of the requirements of the medical or hospital school which the student plans to enter. Modifications will be suggested by the student's adviser and submitted to the Dean of the College of Sciences and Humanities for approval. Students completing three years of preprofessional work at Iowa State University may finish requirements of the curriculum in Sciences and Humanities by transfer of acceptable credits from a recognized medical or hospital school.

**Preparation for International Service**

Academic study of international affairs and pre-professional training for careers in the foreign service, other government agencies, or in foreign trade sections of business, are provided through the International Service Program. Students in this program will major in Economics, Government, History, Industrial Administration, Foreign Languages, or Sociology.
Curriculum in Chemistry

In addition to the courses listed below each student will be required to include physical education in his schedule each quarter during the freshman and sophomore year.

<table>
<thead>
<tr>
<th>FALL QUARTER</th>
<th>WINTER QUARTER</th>
<th>SPRING QUARTER</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Credits</td>
<td>Credits</td>
</tr>
<tr>
<td>Chem. 100</td>
<td>1</td>
<td>Chem 100</td>
</tr>
<tr>
<td>General Chemistry</td>
<td></td>
<td>Syst Inorganic Chem</td>
</tr>
<tr>
<td>Chem 102A or</td>
<td>4</td>
<td>Chem 103 or</td>
</tr>
<tr>
<td>Prin of Modern Chem</td>
<td></td>
<td>Prin of Modern Chem</td>
</tr>
<tr>
<td>Chem 107*</td>
<td></td>
<td>Chem 108*</td>
</tr>
<tr>
<td>Prin of Composition</td>
<td></td>
<td>Prin of Composition</td>
</tr>
<tr>
<td>Engl 101</td>
<td>3</td>
<td>Engl 102</td>
</tr>
<tr>
<td>Anal Geom and Calc I</td>
<td></td>
<td>Anal Geom and Calc II</td>
</tr>
<tr>
<td>Math 110</td>
<td>5</td>
<td>Math 111</td>
</tr>
<tr>
<td>Elementary German</td>
<td></td>
<td>Elementary German</td>
</tr>
<tr>
<td>F L 131</td>
<td>4</td>
<td>F L 132</td>
</tr>
<tr>
<td></td>
<td><strong>17</strong></td>
<td><strong>17</strong></td>
</tr>
</tbody>
</table>

*Students with superior training in high school mathematics, chemistry and physics may expect to begin with Chem 107, 108 and Math 110, 111.
<table>
<thead>
<tr>
<th></th>
<th>FALL QUARTER</th>
<th>WINTER QUARTER</th>
<th>SPRING QUARTER</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Credits</td>
<td>Credits</td>
<td>Credits</td>
</tr>
<tr>
<td>Sophomore Year</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inorganic Chemistry</td>
<td>Chem 203 3</td>
<td>Quantitative Analysis</td>
<td>Chem 215 5</td>
</tr>
<tr>
<td>General Physics</td>
<td>Phys 221 5</td>
<td>General Physics</td>
<td>Phys 222 5</td>
</tr>
<tr>
<td>Amer Government</td>
<td>Govt 215* 3</td>
<td>Electives 6</td>
<td>Electives 6</td>
</tr>
<tr>
<td>Electives</td>
<td>6</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>17</td>
<td>16</td>
<td>16</td>
</tr>
</tbody>
</table>

* May be taken any quarter after the freshman year

|            |            |                |                |
| Junior Year |              |                |                |
| Physical Chemistry | Chem 325, 327 6 | Physical Chemistry | Chem 326, 327 6 |
| Fundamentals of Speech | Sp 211 3 | Electives 4 | Electives 6 |
| Elective | 3            |                |                |
|            | 17           | 17             | 16             |

| Senior Year |            |                |                |
| Adv Inorganic Chemistry | Chem 401, 402 5 | Approved Engr | Electives 3 |
| Approved Engr | Elective 3 | Electives 13 | Chem E 411 3 |
| Electives | 9            |                |                |
|            | 17           | 16             | 16             |

Of the 73 elective credits, at least 21 must be in advanced Chemistry, Biochemistry, Biophysics, Physics, Mathematics, Biological Science or Chemical Engineering. Of these 21, six credits must be advanced Chemistry or advanced Biochemistry and should be in lecture courses. Of the remaining 52 credits, 9 must be in Biological Science; 9 must be in History, Literature, Philosophy, or advanced English composition; at least six must be in Economics, Industrial Administration, Sociology, Psychology or Government (other than Govt. 215); and at least six must be selected from an approved list of engineering courses. Twenty-two credits are not specified.

Curriculum in Physical Education for Men

Leading to the degree Bachelor of Science. A program alternative to the major in Physical Education for Men under the curriculum in Sciences and Humanities.

One unit (one year) of high school algebra is required for admission into this curriculum.

Two hundred five credits must be earned in accordance with the following regulations for graduation:
FALL QUARTER | WINTER QUARTER | SPRING QUARTER
---|---|---
Freshman Year | Credits | Credits | Credits
Prin. of Composition | 3 | Prin. of Composition | 3
Engl. 101 | 3 | Engl. 103 | 3
Intro. to Phys. Ed. | 3 | Phys. Ed. Techniques | 3-6
General Psychology | 3 | Intro. to Sociology | Elective
Psych. 101 | 3 | Soc. 134 | 3
Health Education | 3 | Freshman P.E. | Freshman P.E.
Hyg. 104 | 3 | 102 or 190 | 103 or 190 | 1
Freshman P. E. | 3 to 5 credits in physical or biological science each quarter of the freshman year, including Zool. 155. This program will be modified to allow qualified students to carry Mathematics and Chemistry each quarter.

Sophomore, Junior and Senior Years

The student shall, 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. Basic General Courses: A minimum of 39 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 areas of animal biology and hygiene.
4. Courses selected toward proper vocational preparation in accordance with the student's interests:

Teaching and Coaching.

a. A maximum of 60 credits in physical education shall apply toward the degree.
b. Completion of prescribed core education professional courses. See Teacher Education.
c. Completion of prescribed requirements in either two half-time areas or one full-time area of teaching certification in addition to physical education. These may be elected from agricultural sciences, Driver Education, English, Industrial Education, Social Studies, General Science or Mathematics.

Journalism and Broadcasting in preparation for sports writing and sportcasting.

a. A maximum of 60 credits in physical education.
b. Partial completion of the core education professional courses including 3 credits in education, 9 credits in educational psychology, 3 credits in American Government.
c. A minimum of 40 credits in Journalism and Telecommunicative Arts.

Supervised Recreation in preparation for leadership of community or industrial supervised recreation programs. Limited to those seniors who elect the Supervised Recreation Program for specialization during their last year.

a. A maximum of 60 credits in Physical Education, 20 of which may be concentrated in the area of Supervised Recreation.
b. Partial completion of the core education professional courses including 3 credits in Education, 9 credits in Psychology, 3 credits in American Government.
c. A minimum of 45 credits shall be distributed among the areas of Driver-Training, English, Industrial Education and Social Studies.
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 and the hospital and ambulatory clinics, there are also the Veterinary Medical Research Institute and the Iowa Veterinary Medical Diagnostic Laboratory, which 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 will take at least three years' work in the curriculum 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 earn the degree Doctor of Veterinary Medicine, candidates must be 21 years of age, of good moral and professional character, must have at least two quality points per credit in all courses taken in the professional curriculum, and must be approved by all departments of the college.

Opportunities in Veterinary Medicine for the Graduate

Private Practice. The extent and importance of the livestock industry in the United States assure the veterinarian opportunity to establish a professional career in private practice. The success of livestock production is becoming more and more a problem of controlling animal diseases. The veterinarian has definite responsibilities in a successful animal industry, and the majority of veterinarians enter some phase of veterinary medicine practice upon graduation. In recent years there has been a developing tendency toward specialization in certain fields of practice, for example, in breeding diseases, or in cattle, swine, or poultry practice. One of the attractive fields of professional work is small animal practice. Many veterinarians now maintain private hospitals adequately equipped for the diagnosis and treatment of diseases of household pets, and devote their entire time to this field of specialization.

The Agricultural Research Service. The Agricultural Research Service of the United States Department of Agriculture employs more veterinarians than any other agency, many hundreds being utilized in its widespread national activities. Its services 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, both in laboratories and in the field. These positions are obtained through the United States Civil Service Commission by examination and ordinarily are available for those wishing to enter this service.
State and Municipal Governments. Every state has a state veterinarian or similar officer, often with a number of assistant veterinarians whose duties are to investigate and control preventable diseases of animals by enforcing the laws and regulations established for this purpose. Veterinary medical health officials cooperate with those of human medicine in state health matters, as many animal diseases are communicable to man. Many cities employ veterinarians on a full or part time basis as sanitarians in their public health departments. Their responsibilities are to insure the healthfulness of the cities' food supply with special reference to milk and meat products. The milk supply is supervised as to its source and sanitary conditions under which it is produced, and the health of the dairy herds supplying the milk is investigated.

Veterinary Corps, United States Army and United States Air Force. Students in Veterinary Medicine usually are deferred by their local Selective Service Boards in order to complete their professional education. Upon graduation, some are required to serve two years in the Army or the Air Force. Upon entering the service, the veterinary graduate is commissioned as a captain. If he wishes to remain in service, advancement is made in the various grades through the rank of colonel, with one officer appointed in the grade of brigadier general. One of the major responsibilities of the veterinary corps officers is determining that food products, especially those of animal origin, issued to the Armed Services are wholesome and suitable for food purposes. The protection of all animals and birds essential to war activities is a responsibility of the Army and Air Force veterinarian. His familiarity with diseases transmissible from animals to man, his training in laboratory techniques and knowledge of parasitic diseases make him a valuable addition to the public units of the military service.

Commercial Work. 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. These positions may require some special training and include both technical laboratory and field work.

Education and Research. Veterinarians qualified by special training are in demand to fill teaching and research positions in veterinary medical, medical and agricultural colleges. Almost every agricultural school has a veterinary medical department employing several
veterinarians, and the veterinary medicine colleges of the country constantly are looking for veterinarians qualified for institutional work. Research veterinarians are attached to state agricultural experiment stations in addition to those employed by the United States Agricultural Research Service.

Public Health Service. Many veterinarians are employed in public health. The Communicable Disease Center of the United States Public Health Service assigns veterinarians in their employ to various sections of the country where special disease problems exist. Cities and small towns often employ veterinarians to aid in controlling the food supply and also diseases which are transmissible from animals to man, such as rabies. Some of these positions are on a full time basis but many are part time employment. In many of the states a veterinarian is employed by the State Health Department to assist in the field of epidemiology and health education. Veterinarians also are employed by the Pan-American Sanitary Bureau and by the World Health Organization.

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 bio-astronautical 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, 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>12 qr crs. (8 sem. crs)</td>
</tr>
<tr>
<td>Must include 3 qr. crs. (2 sem. crs.) of speech-making (Sp. 211 or equivalent)</td>
<td></td>
</tr>
<tr>
<td>General Chemistry</td>
<td>12 crs.</td>
</tr>
<tr>
<td>Quantitative 4</td>
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<tr>
<td>Organic 8</td>
<td></td>
</tr>
<tr>
<td>Mathematics (algebra &amp; trig.)</td>
<td>9 crs. (6 sem. crs)</td>
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<tr>
<td>Physics</td>
<td>12 crs. (8 sem crs)</td>
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<tr>
<td>Zoology 8</td>
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<tr>
<td>Botany 3</td>
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<tr>
<td>Genetics 3</td>
<td></td>
</tr>
<tr>
<td>Biological Science</td>
<td>14 crs. (10 sem. crs)</td>
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<tr>
<td>American Government</td>
<td>3 crs. (2 sem crs)</td>
</tr>
<tr>
<td>Electives</td>
<td>16 crs. (10 sem crs)</td>
</tr>
<tr>
<td>Must include course in library orientation</td>
<td></td>
</tr>
<tr>
<td>TOTAL</td>
<td>90 qr crs (60 sem. crs)</td>
</tr>
</tbody>
</table>
Pre-professional students at Iowa State University enroll in either the College of Agriculture or the College of Science 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 a Bachelor of Science Degree in the College of Agriculture or in the College of Science 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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<tbody>
<tr>
<td><strong>Credits</strong></td>
<td><strong>Credits</strong></td>
<td><strong>Credits</strong></td>
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<td>Microscopic Anatomy</td>
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<td>Microscopic Anatomy</td>
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<td>V Anat 303</td>
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<td>Gross Anatomy</td>
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<td>Lab in Physiological Chemistry</td>
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<td>B &amp; B 305, 315</td>
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<td>Comparative Mammalian Phys</td>
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<td>V Phys &amp; Pharm 316</td>
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<td>V Anat 300</td>
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FALL QUARTER | WINTER QUARTER | SPRING QUARTER |
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<tbody>
<tr>
<td><strong>Credits</strong></td>
<td><strong>Credits</strong></td>
<td><strong>Credits</strong></td>
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<tr>
<td>Pharmacology &amp; Therapeutic Prin</td>
<td>Pharmacology</td>
<td>Disturbances of Reproduction</td>
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<tr>
<td>V Phys &amp; Pharm 367</td>
<td>V Phys and Pharm 368</td>
<td>V Clin Sci 391</td>
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<tr>
<td>Gen Bacteriology &amp; Immunology</td>
<td>Pathogenic Bacteriology</td>
<td>General Surgery</td>
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<tr>
<td>Animal Nutrition I</td>
<td>Animal Nutrition II</td>
<td>Virology &amp; Epidemiology</td>
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<tr>
<td>General Pathology</td>
<td>Parasitology</td>
<td>General Medicine</td>
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<td>V Path 371</td>
<td>V Path 376</td>
<td>V Clin Sci 394</td>
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<td><strong>Credits</strong></td>
<td><strong>Credits</strong></td>
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18 18 17

Second Year

19 19 21
### FALL QUARTER

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<th>Course</th>
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<tbody>
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<td>Special Surgery I*</td>
<td>2</td>
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<tr>
<td>V Clin. Sci. 441</td>
<td>2</td>
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<td>Applied Anatomy*</td>
<td>3</td>
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<tr>
<td>V Anat. 406</td>
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<tr>
<td>Clinical Medicine I</td>
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<tr>
<td>V Clin. Sci. 444</td>
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<tr>
<td>Infectious Diseases</td>
<td>3</td>
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<tr>
<td>V. Micro &amp; Prev. Med. 431</td>
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<tr>
<td>Special Pathology</td>
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<tr>
<td>V. Path. 421</td>
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<tr>
<td>Vet. Clinical Sciences</td>
<td>2</td>
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<td>V Clin. Sci. 447</td>
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### WINTER QUARTER

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<tbody>
<tr>
<td>Special Surgery II</td>
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<tr>
<td>V Clin. Sci. 442</td>
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<td>Clinical Medicine II</td>
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<tr>
<td>Infectious Diseases</td>
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<tr>
<td>V. Micro &amp; Prev. Med. 432</td>
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<tr>
<td>Special Pathology</td>
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<td>V. Path. 422</td>
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<tr>
<td>Vet Clinical Sciences</td>
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<td>V Clin. Sci. 448</td>
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### SPRING QUARTER

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<td>Special Surgery III</td>
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<tr>
<td>Radiology</td>
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<tr>
<td>V Clin. Sci. 440</td>
<td>3</td>
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<tr>
<td>Clinical Medicine III</td>
<td>3</td>
</tr>
<tr>
<td>V Clin. Sci. 446</td>
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<tr>
<td>Infectious Diseases</td>
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<tr>
<td>Special Pathology</td>
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<tr>
<td>V Path. 423</td>
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<tr>
<td>Vet. Clinical Sciences</td>
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<tr>
<td>V Clin. Sci. 449</td>
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<tr>
<td>Vet. Toxicology and Poisonous Plants**</td>
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<td>V Path. 456</td>
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### First or Second Summer Session

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<tr>
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<tr>
<td>Applied Vet. Sci</td>
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<tr>
<td>V Clin Sci 491</td>
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### FOURTH YEAR

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<tr>
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<tr>
<td>Applied Vet. Sci</td>
<td>13</td>
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<tr>
<td>V Clin Sci 492***</td>
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<tr>
<td>Seminar</td>
<td>13</td>
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<tr>
<td>V Clin Sci 493***</td>
<td>13</td>
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<tr>
<td>Public Health I</td>
<td>2</td>
</tr>
<tr>
<td>V Clin Sci 496</td>
<td>2</td>
</tr>
<tr>
<td>V Micro &amp; Prev. Med. 484</td>
<td>3</td>
</tr>
<tr>
<td>Public Health II</td>
<td>3</td>
</tr>
</tbody>
</table>

### 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.

*Cross listed in both V. Anat. and V. Clin. Sci.
**Cross listed in both Botany and V. Path.
***Taught by all veterinary departments.
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 of 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 five colleges, the Librarian, Dean of Admissions and Records, heads of departments offering graduate work, and members of the General Faculty who are elected to membership in recognition of their accomplishments in their respective disciplines.

The Graduate College offers opportunities to pursue advanced study in the different fields of agriculture, engineering, home economics, the sciences and veterinary medicine. Most of the graduate programs offered are research-oriented and lead to the degrees Master of Science and Doctor of Philosophy.

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 pay a maximum of $310-$320 per month and 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 $52 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

Arrangements for formal post doctoral study should be made through application to the Graduate Dean.
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. 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. The Graduate Dean may make an exception for students to whom English is not the native language.
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 $17 per credit.

"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 head of his major department may request 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. Gen-
eral 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 this institution.

Any transfer of credits from another institution must be recommended in the Program of Study by the student's advisory committee. Transfer of graduate credit will be approved only if it is of "B" grade or better.

**Major and Minor.** The exact number of credits in major and minor fields is not prescribed. To obtain the specialization which is considered essential for an advanced degree, approximately two-thirds of the work should be devoted to the major field, but this is not necessarily restricted to one department. 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.** Except where specifically waived in the description of requirements of the student's major department in the Graduate College Catalog, a satisfactory reading knowledge of German, French, Russian or other language for which departmental approval has previously been obtained must be demonstrated.

The University utilizes the standardized examinations provided by the Educational Testing Service. These tests are administered at the University and at many other places throughout the United States four times yearly on announced dates. Scores obtained on any of these examinations may be transmitted to the University for its use and students are urged to acquire foreign language competence as undergraduates, or as early as possible in their graduate career. Satisfactory scores obtained in the ETS examinations prior to admission are acceptable and students are strongly urged to establish competence before entering the Graduate College.

For students whose native language is not English, the ability to communicate adequately in English (certified by the Department of English) will 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 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. 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 Librarian. 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. 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 Architecture:**

General requirements are the same as those for the degree Master of Science with 36 credits in residence required. The student may elect to pursue a no-thesis program which requires 54 credits.

**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 no-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. 36 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 his 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 institution must be recommended in the Program of Study by the student's advisory committee. Transfer of graduate credit will be approved only if it is of "B" grade or better.

Major and Minor. To avoid overspecialization, a significant body of pertinent course work must be taken outside of the major field. The work outside the major field should amount to approximately 18 hours of applicable graduate credit as required by the student's committee.

The major field is equivalent to the major department except for: (1) established interdisciplinary majors and (2) disciplines within departments which may be approved by the Graduate Committee.

Foreign Languages. At the discretion of the student's committee, the foreign language requirement may be met in either of two ways:

1. Demonstrate a satisfactory reading knowledge of two of the following—German, French, Russian or any foreign language for which departmental approval has previously been obtained.

2. Demonstrate a significantly higher degree of communication competence for one of the languages indicated under the preceding alternative.

For students whose native language is not English, the ability to communicate in English, certified by the Department of English, will be acceptable as a substitution for reading knowledge of one foreign language.

The University utilizes the standardized examinations provided by the Educational Testing Service. These tests are administered at the University and at many other places throughout the United States four times yearly on announced dates. Scores obtained on any of these examinations may be transmitted to the University for its use and students are urged to acquire foreign language competence as undergraduates, or as early as possible in their graduate career. Satisfactory scores obtained in the ETS examinations prior to admission are acceptable and students are urged to establish competence before entering the Graduate College.

The language requirement 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 Librarian 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 Librarian.

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 Librarian. 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.

Hoods. Candidates for the degree Doctor of Philosophy will be required either to purchase or to rent hoods to be used at the time the degree is conferred. Arrangements are made through the Office of Student Records.
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 12 weeks. The abbreviation "Cr. H." 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 of 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 1968" identifies courses to be available during the 1967-68 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.; Frederick W. Stuve, M.S.
Assistant Professors: Paul J. Hermann, M.S.; William D. James, M.S.; Leverne K. Seversike, Ph.D.

Opportunities for 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 is available in the Aerospace Engineering Department. See College of Engineering Cooperative Programs.
Opportunities for 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 field for this degree.

Prerequisite to major graduate work is the completion of a curriculum substantially equivalent to that required of undergraduate students in aerospace engineering at this institution.


COURSES PRIMARILY FOR UNDERGRADUATE STUDENTS

100. TECHNICAL LECTURE
        (1-0) Cr. R.S.
        Orientation in the field of aerospace engineering

244 AERODYNAMICS I
        (2-0) Cr. 2. F
        Prerequisite: Math. 112, 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

271, 272, 273 AEROSPACE LABORATORY.
        (0-3) Cr. 1 each, F.W.S.
        Prerequisite: 271: Credit or classification in 244; 272: Credit or classification in 245; 273: Credit or classification in 342, E.M. 324.
        Practical application of aerospace principles and concepts through laboratory experiments

300 INSPECTION TRIp.
        S.
        Prerequisite: Junior Aer E. 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 W.
        Prerequisite: E.M. 324, Met. 202.
        Properties of materials used in flight vehicles, objectives of design, analysis of elementary structures

321 STRUCTURAL ANALYSIS.
        (3-0) Cr. 3 S.
        Prerequisite: 320.
        Use of energy methods and matrices in the calculation of deflections of structures of flight vehicles and in the analysis of statically indeterminate structures of flight vehicles. Analysis of webs in shear. Compression of stable and unstable sections

331 AEROSPACE INSTRUMENTATION.
        (3-0) Cr. 3 S.
        Prerequisite: E.E. 445.
        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

342. PERFORMANCE OF AEROSPACE VEHICLES.
        (3-0) Cr. 3 S.
        Prerequisite: 245.
        Performance of aerospace vehicles.

343. STABILITY AND CONTROL I.
        (3-0) Cr. 3 F.
        Prerequisite: 342. classification in Math. 410.
        Static stability and control of flight vehicles. Rigid body equations of motion

344. STABILITY AND CONTROL II.
        (3-0) Cr. 3 W.
        Prerequisite: 343.
        Dynamic stability and control of flight vehicles

352. MISSILE AND SPACE THEORY I.
        (3-0) Cr. 3 F.
        Prerequisite: Math. 322, E.M 344.
        Introduction to astronautics and orbital flight mechanics.

353. MISSILE AND SPACE THEORY II.
        (3-0) Cr. 3 S.
        Prerequisite: 352.
        Trajectories of missiles and space flight vehicles

371, 372, 373 AEROSPACE LABORATORY.
        (0-3) Cr. 1 each, F.W.S.
        Prerequisite: 371: Credit or classification in 343 and 352; 372: Credit or classification in 320 and 344; 373: Credit or classification in 309, 321, 331, and 353.
        Practical application of aerospace principles and concepts through laboratory experiments

411. REACTION PROPULSION II.
        (3-0) Cr. 3 F.
        Prerequisite: 309.
        Turbojet, ramjet and rocket propulsion

413. REACTION PROPULSION III.
        (3-0) Cr. 3 W.
        Prerequisite: 411.
        Advanced propulsion theory. Exotic and space propulsion systems.

421. PROBLEMS IN FLIGHT VEHICLE HEATING.
        (3-0) Cr. 3 W.
455. 456. INTRODUCTION TO HYDROSACE ENGINEERING.
(3-0) Cr. 3. each. W.S.
Prerequisites: 344.
Introduction to elementary hydrospace vehicle performance, stability and control, and physical oceanography. Application of hydrospace principles to motion of vehicles under, on or above the surface and instrumentation for hydrospace research

461. DESIGN AND ANALYSIS I.
(1-6) Cr. 3. W.
Prerequisite: Senior classification.
Application of the principles and methods of analysis and design to the solution of aerospace problems

462. DESIGN AND ANALYSIS II.
(1-6) Cr. 3. S.
Prerequisite: 461.
Application of the principles and methods of analysis and design to the solution of aerospace problems.

463. DESIGN AND ANALYSIS III.
(1-6) Cr. 3. S.
Prerequisite: 462.
Application of the principles and methods of analysis and design to the solution of aerospace problems.

470. AEROSPACE PROBLEMS.
Arr. Cr. 1 to 6. F.W.S.
Prerequisite: 344.
A. Aero and/or Gas dynamics
B. Propulsion.
C. Stress Analysis.
D. Missile and Space Theory
E. Flight Systems

471. 472, 473. AEROSPACE LABORATORY.
(0-3) Cr. each. F.W.S.
Prerequisite: 471: Credit or classification in 411, 431, and 441; 472: 471; 473: 472.
Practical application of aerospace principles and concepts through laboratory experiments.

480. FUNDAMENTALS OF AEROELASTICITY.
(3-0) Cr. 3. S.
Prerequisite: 344. E.M. 444.
Application of vibration theory and matrix analysis to elastic structures; eigen-value solutions of boundary value problems.

491. 492, 493. AEROSPACE SEMINAR.
(1-0) Cr. R. Yr.

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. AUTOMATIC CONTROLS FOR FLIGHT VEHICLES.
(3-0) Cr. 3. Alt. W. Offered 1969.
Prerequisite: 431.
Theory of the automatic control of flight vehicles. Application of servo-mechanisms to weapon systems.

532. AUTOMATIC CONTROLS FOR FLIGHT VEHICLES.
(3-0) Cr. 3. Alt. S. offered 1969.
Prerequisite: 531.
Theory of the automatic control of flight vehicles. Application of servo-mechanisms to weapon systems.

541, 542, 543. ADVANCED AERODYNAMICS.
(M.E. 541, 542, 543) (3-0) Cr. 3 each. Yr.
Prerequisite: 544.
Classical flow theory, compressible fluid theories and shock wave studies

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.
FLIGHT PROPULSION SYSTEMS. (M.E. 545) See Mechanical Engineering.

EXPERIMENTAL GAS DYNAMICS AND SHOCK TUBE THEORY. (M.E. 549) See Mechanical Engineering.

MISSION THEORY. (3-0) Cr. 3. F.W. Prerequisite: 344, Math. 410. Dynamics, propulsion, and guidance of missiles. Orbital flight

PERFORMANCE ANALYSIS. (2-3) Cr. 3. S. Prerequisite: 551. Performance of aircraft, missiles and space vehicles

ENTRY DYNAMICS. (3-0) Cr. 3. S.

COURSES FOR GRADUATE STUDENTS, major or minor

AEREOELASTICITY. (3-0) Cr. 3 each Alt. W.S. Offered 1968. 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 aerelastic problems

OPTIMIZATION IN AEROSPACE ENGINEERING. (3-0) S. Cr. 3 each. Alt. W.S. Offered 1969. 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

SEMINAR. (1-0) Cr. 1.


HYPERSONIC FLOW THEORY. (3-0) Cr 3 each. Alt. F.W. Offered 1967. Prerequisite: 543 or equivalent. High Mach number flow theory. Theories of slender, blunt-nosed, and slightly blunt-nosed bodies in hypersonic flow. Minimum drag bodies. Hypersonic shock wave, small disturbance and Newtonian theories

Atmospheric entry and entry dynamics of missiles and space vehicles.

DESIGN AND ANALYSIS. (2-6) Cr. 4. S. Prerequisite: 462 or equivalent, Math. 410. Methods of analysis and theory of design. Applications to design problems of aircraft, missile and space vehicles and their trajectories


HYPERSONIC VISCOUS FLOWS. (3-0) Cr. 3. Alt. S. Offered 1968. Prerequisite: 642, Math. 416 or equivalent. Hypersonic boundary layer and viscous flow studies. Applications to slender and blunt bodies

APPLIED WING THEORY. (3-0) Cr. 3. Alt. F. Offered 1968. Prerequisite: 542, Math. 416 or equivalent. Methods of estimating the aerodynamic characteristics of swept and unswept, steady and oscillating wings in subsonic and supersonic flight

THE DYNAMICS OF REAL GASES. (3-0) Cr. 3 each. Alt. yr. Offered 1967. Prerequisite: 542, Math. 322. Application of real gas theory to flow behind a strong shock and in a rocket expansion nozzle. Involves harmonic and anharmonic oscillator theory, collisional transition probabilities, vibrational and chemical relaxation together with their coupling effects at high temperatures

FLUID MECHANICS SEMINAR. (E.M. 650, M.E. 650) (1-0 to 3-0). Cr. 1 to 3 each time taken. Prerequisite: Permission of instructor. Special topics of current research interest to students and staff of departments concerned

MECHANICS OF SPACE VEHICLE TRANSFERS. (3-0) Cr. 3 each. Alt. W.S. Offered 1969. Prerequisite: 523. 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

RESEARCH. D. Anderson, E. Anderson, Iversen, Hsu, Millett, Seversike

AGRICULTURAL BUSINESS

For description of courses, see Economics and Sociology

AGRICULTURAL EDUCATION

For description of courses, see Education

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.; Ted L. Wilrich, Ph.D.


Instructors: Donald L. Ahrens, M.S.; Samuel I. Ajiri, B.S.; Herbert E. Hansen, B.S.; Gary C. McVey, B.S.; James A. Merkel, M.S.; Clarence E. Johnson, B.S.

Opportunities for 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 machinery 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, with certain companies in the farm machinery industry. The four-year curriculum is extended over a five-year period and interspersed with work periods in a farm machinery manufacturing plant. This plan offers valuable practical experience and financial assistance during the years in college.

In addition to the courses for students majoring in agricultural engineering, the department offers a number of courses for students from the College of Agriculture. These include courses in farm mechanics, soil and water control, farm power and machinery, farm electrification, farm structures, and crop storage and conditioning.

Opportunities for Graduate Study

The department offers major work for the degrees Master of Science, Master of Engineering, and Doctor of Philosophy in soil and water control; agricultural field power and machines; agricultural electric power and crop processing; agricultural structures and equip-
Description of Courses

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.
(1-2) Cr. 2. W.
Prerequisite: For students in Winter Quarter Farm Operation Program only.
Calibration, selection, management and cost of using farm machinery

154. AGRICULTURAL MAINTENANCE WELDING.
(2-4) 5 weeks. Cr. 2 W.
Prerequisite: For students in Winter Quarter Farm Operation Program only.
Selection of welding machines and materials and their application in agriculture

157. DAIRY MECHANICS.
(0-6) Cr. 2. S.
For dairy and food industries students Sanitary and common pipe fitting, soldering and sheet metal, oxy-acetylene and arc welding, silver soldering, electricity, and service and repair of dairy equipment

217. ENGINEERING PROBLEMS IN LIVESTOCK PRODUCTION.
(4-0) Cr. 4 W.
Prerequisite: Math. 112. credit or classification in Phys. 222.
Environmental influences on livestock production Functional design of livestock housing and equipment

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.

224 FUNDAMENTALS OF SOIL AND WATER CONTROL ENGINEERING
(3-6) Cr. 5 S
Prerequisite: Agron. 154, credit or classification in Math. 112.

236. AGRICULTURAL MACHINES.
(2-3) Cr. 3. F.
Prerequisite: Credit or classification in Math. 111.
The effect of mechanical treatment on soils and farm crops. Efficiency and functional analysis of agricultural machines

254. METAL CONSTRUCTION AND MAINTENANCE.
(2-4) Cr. 3. F.W.S.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.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-metallurgical materials. Welding, metalurgy, 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.SSII.
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 draining 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

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* A student cannot count credit for both 134 and 334 toward a degree
** A student cannot count credit for both 154 and 254 toward a degree
346. AGRICULTURAL TRACTOR POWER
(3-3) Cr. 4. S.SSI.
Prerequisite: M.E. 321.
Kinematics and dynamics of tractor power
application, draw bar, power take-off, and
traction mechanisms. Thermodynamic
principles and construction of the internal
combustion engine, fuels and carburetion,
ignition. Rating and testing of tractors

354. ADVANCED METAL CONSTRUCTION
AND MAINTENANCE.
(2-4) Cr. 3. F.W.S.SSI.
Prerequisite: 254.
Advanced techniques in metal construction
and repair of agricultural equipment
including oxy-acetylene and arc welding

359. MACHINE CONSTRUCTION.
(0-6) Cr. 3. F.W.S.
Prerequisite: Chem. 101.
Oxy-acetylene and electric welding. Chemical
and metallurgical principles Selection
of equipment and materials

362. AGRICULTURAL APPLICATIONS OF
ELECTRICAL ENERGY.
(2-3) Cr. 3. F.
Prerequisite: Phys. 223.
Practical application of electric energy to
the farm and farm home; selection, operation,
maintenance, and economics of electric
equipment.

364. FARM ELECTRICITY.
(2-3) Cr. 3. F.W.S.
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 sim-
plification, 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.

401, 402, 403. SEMINAR.
(1-0) Cr. R. Yr.
Preparation, presentation and discussion of papers on agricultural engineering
subjects.

412. ELECTRICITY IN FARMSTEAD
MECHANIZATION.
(2-3) Cr. 3. SSI. Three weeks 1968.
Prerequisite: Permission of instructor.
Planning the farmstead electrical systems
for economy, work simplification and safe-
ty. Characteristics and application of motors and controls to livestock and poultry
production. Development of demonstrations
and instructional materials for the teaching
of mechanization of the farm-

415. TEACHING FARM MECHANICS.
(2-3) Cr. 3. F.W.S.
Prerequisite: 254 or permission of instruc-
tor.
Objectives and methods; equipment and
management of the shop, organization
of shop program. Students will plan and
present demonstrations of methods of teach-
ing mechanical skills.

416. ADVANCED ORGANIZATION AND
TEACHING OF FARM MECHANICS.
(2-3) Cr. 3. Off-campus. S.
Prerequisite: 415 or permission of instruc-
tor.
Trends and the role of farm mechanics in
the mechanization of agriculture. Orga-
ization of instructional areas, selection of
tools, supplies, reference materials, and
facilities. Preparation of instructional ma-
terials and methods of effective teaching.
Development of teaching demonstrations
and procedures.

419. ENVIRONMENTAL SYSTEMS FOR
ANIMAL PRODUCTION.
(3-0) Cr. 3. P.S.
Prerequisite: Math. 101C.
Effects of thermal environment on animal
performance. Ventilation and insulation
for animal housing. Functional planning
of animal facilities. Feed processing sys-
tems. Economic considerations of build-
ings and equipment. Not open to students
having credit in A E. 219.

424. HYDRAULIC DESIGN OF SOIL
AND WATER CONTROL FACILITIES.
(2-3) Cr. 3. F.
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. Hy-
draulics of pumps.

425. IRRIGATION AND DRAINAGE
ENGINEERING.
(2-3) Cr. 3. W.
Prerequisite: 224, 424.
Theory of subsurface drainage. Irrigation
of field crops. Design of surface and sprink-
er irrigation systems. Sedimentation in
channel and reservoir design. Use of com-
puters in solving soil and water conserva-
tion problems.

428. SPECIAL PROBLEMS.
Cr. 1 to 5. F.W.S.SSI, II.
H. Honors program.

436. AGRICULTURAL MACHINERY
DESIGN.
(2-6) Cr. 4. W.
Prerequisite: 238, M.E. 318.
Design, development and testing of farm
machinery to meet the functional require-
ments of machines for tillage, seeding,
cultivation and weed control, harvesting,
crop processing, and farm power units.

447. AGRICULTURAL ENGINEERING
APPLICATIONS.
(3-0) Cr. 3. S.
Prerequisite: 236, 346, E.M. 324.
Summarization, correlation and extension
of the agricultural engineering techniques.
Economic limitations in design and man-
agement.
APPROPRIATIONS OF ELECTRICAL PRINCIPLES TO AGRICULTURAL EQUIPMENT.
(2-6) Cr. 4. W.
Prerequisite: Credit or classification in E.E. 442.
Selection and use of electrical equipment as related to efficiency and economy of agricultural production, processing and storage of feeds, forage crops and grains in connection with the livestock, poultry and dairy enterprises.

FARM ELECTRIFICATION DESIGN
(3-3) Cr. 4. S.
Prerequisite: 461.
Engineering problems in the design of electric distribution systems. Design of control circuits and equipment used in livestock, grain, and forage production.

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.

PROPERTIES AND PROCESSING OF AGRICULTURAL MATERIALS.
(2-3) Cr. 3. S.
Prerequisite: 464.
Theory and practice involved in the handling of agricultural products on the farm.

EROSION AND SEDIMENT TRANSPORT.
(3-0) Cr. 3. W.
Prerequisite: Math. 213 and one of the following: 424, C.E. 521, Geol. 460, Agron. 577.

SPECIAL TOPICS.
Cr 1 to 5. F.W.S.SSI. 11.
A. Power and Control Hydraulics

AGRICULTURAL STRUCTURES AND EQUIPMENT.
(3-0) Cr. 3. F.
Prerequisite: 488.
Critical analysis of the design and functional relation of farm structures and equipment, including research methods, project planning and reporting of results.

AGRICULTURAL STRUCTURES.
(2-3) Cr. 3. F.
Prerequisite: 217, E.M. 324.
Structural problems in agricultural buildings. Valuation appraisal and estimation. Design of major service and processing buildings.

ADVANCED AGRICULTURAL STRUCTURES.
(2-3) Cr. 3. S.
Prerequisite: 217, credit or classification in C.E. 434.
Analysis of statically determinate agricultural buildings. Analysis and design of specialized structures for service, storage, or processing of agricultural commodities. Specifications. Special reports.

ENVIRONMENTAL CONTROL IN AGRICULTURAL STRUCTURES.
(2-3) Cr. 3. W.
Prerequisite: 475 or C.E. 331, M.E. 321.

FARM BUILDINGS AND EQUIPMENT.
(2-3) Cr. 3. W.
Prerequisite: Senior classification.

ADVANCED SOIL AND WATER CONTROL ENGINEERING.
(3-0) Cr. 3. W.
Prerequisite: 425.
Critical analysis of the design and functional relations of soil and water conservation facilities. Including experimental techniques.

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.

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.

RESEARCH
F.W.S.SSI. 11.
Beer, Beresford, Bockhop, Buchele. Charity, Giese, Hazen, Hukill, Johnson.

SOIL DYNAMICS.
(2-3) Cr. 3. W.
Prerequisite: E.M. 324, 344; Agron. 577 or C.E. 360.

AGRICULTURAL STRUCTURES.
(2-3) Cr. 3. F.
Prerequisite: 217, E.M. 324.
Structural problems in agricultural buildings. Valuation appraisal and estimation. Design of major service and processing buildings.

ADVANCED AGRICULTURAL STRUCTURES.
(2-3) Cr. 3. S.
Prerequisite: 217, credit or classification in C.E. 434.
Analysis of statically determinate agricultural buildings. Analysis and design of specialized structures for service, storage, or processing of agricultural commodities. Specifications. Special reports.

ENVIRONMENTAL CONTROL IN AGRICULTURAL STRUCTURES.
(2-3) Cr. 3. W.
Prerequisite: 475 or C.E. 331, M.E. 321.

FARM BUILDINGS AND EQUIPMENT.
(2-3) Cr. 3. W.
Prerequisite: Senior classification.

ADVANCED SOIL AND WATER CONTROL ENGINEERING.
(3-0) Cr. 3. W.
Prerequisite: 425.
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AGRICULTURAL POWER AND MACHINERY.
(3-0) Cr. 3. S.
Prerequisite: 346.
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RESEARCH
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(2-3) Cr. 3. F.
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(2-3) Cr. 3. S.
Prerequisite: 217, credit or classification in C.E. 434.
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ENVIRONMENTAL CONTROL IN AGRICULTURAL STRUCTURES.
(2-3) Cr. 3. W.
Prerequisite: 475 or C.E. 331, M.E. 321.

FARM BUILDINGS AND EQUIPMENT.
(2-3) Cr. 3. W.
Prerequisite: Senior classification.
AGRICULTURE

Floyd Andre, Ph.D., Dean of Agriculture
Louis M. Thompson, Ph.D., Associate Dean

Professors: Roger L. Mitchell, Ph.D.; James J. Wallace, B.S.
Assistant Professor: Jack M. Alexander, M.S.

Instructors: Donald L. Ahrens, M.S.; Roger J. Bruene, B.S.; Ronald D. Kay, B.S.; Neil A. Patrick, B.S.; David L. Stamp, B.S.

Courses Administered by the College of Agriculture

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.
Prerequisite: Junior classification in College of Agriculture. Patrick, Wallace.
Credit not to exceed 4 in any quarter and not to exceed a total of 8. Participation in the management and operation of an Iowa farm. The class is responsible for the plans, records and decisions of buying and selling of livestock, crops and equipment. Trips to farms and markets.

490. SPECIAL PROBLEMS.
Cr. 1-3. 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. 1-3.
Current topics of importance in Agriculture. Lectures by College of Agriculture staff.

AGRONOMY

John T. Pesek, Jr., Ph.D., Head of Department


Assistant Professors: W. Gale Biggs, Ph.D.; Alfred J. Englehorn, M.S.; Thomas E. Fenton, Ph.D.; Detroy E. Green, Ph.D.; Oliver A. Knott, M.A.; Raymond P. Nicholson, B.S.; Frederick R. Troeh, Ph.D.

Instructors: Vernon B. Cardwell, M.S.; David L. Stamp, B.S.
Opportunities for Undergraduate Study

For undergraduate curriculum in agronomy, see College of Agriculture, Curricula. The curriculum in agronomy provides a thorough training in crop science, soil science and agricultural climatology. It also provides general training in other fields of agriculture, in natural and social sciences, and in the humanities.

The four-year curriculum, with its four majors outlined under the agronomy curriculum, prepares students for independent farming and for positions in industry, service organizations, educational institutions and state and federal agencies. Graduates accept positions in the seed, fertilizer and chemical industries as agronomists, production managers, product inspectors and sales and promotion specialists. They are employed in state and federal agencies as extension agronomists, county extension directors, soil conservationists and soil scientists. There are also opportunities for agronomy graduates as land appraisers, turf-grass specialists and farm managers.

All of the undergraduate courses described below are approved for major and minor credit in Agronomy except 110, 114A, 114B, 154A, 154B, 300 and 400.

Opportunities for 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.

Prerequisite to major graduate work in crop science and soil science is completion of an undergraduate curriculum substantially equivalent to that recommended for pre­graduate training in the agronomy curriculum at this institution.

Open to graduate students for minor only: 315, 354, 415, 416, 424, 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: (3-2) Cr. 4. F.W.S.SSI.
B: (3-0) Cr. 3. W. For students in winter quarter Farm Operation Program only.
Introductory 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. W. 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. AGRICULTURAL METEOROLOGY.
(geophys. 206) (3-0) Cr. 3. F.W.
Introduction to basic meteorological processes related to agriculture. Study of weather maps and forecasting.

212. GRAIN AND FORAGE CROPS.
(3-2) Cr. 4. 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.

300. CROP PRODUCTION AND SOIL MANAGEMENT.
Cr. Arr. F.W.S.SS.
For special groups. Distribution, production, harvesting and utilization of crops; formation, characteristics and classification of soils; principles and practices of soil conservation, fertility maintenance and soil management.

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.

313, 314. TURFGRASS MANAGEMENT.
(Hort. 313, 314) See Horticulture.

315. CROP GROWTH AND CULTURE.
(4-0) Cr. 4. F.S. Alt. SSI. Offered 1968
Prerequisite: 114, Bot. 101 or 210, Chem. 101.
Basic concepts and physiologic aspects of growth and culture of crop plants, application of these principles to cultural practices.

354. SOIL FERTILITY.
(3-3) Cr. 4. F.W.S.SSI.
Prerequisite: 154, Chem. 231.
Chemical, biological and physical properties of soils in relation to plant nutrition Principles relating to the use of time, 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.
Cr. 4. SS.
Prerequisite: Junior or Senior classification, permission of instructor.

B: European Tour offered 1968.
Students taking this course will be required to register also for An. Sci. 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.
(geophys. 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.

411. SEMINAR.
(1-0) Cr. 1. W.S.
Prerequisite: 310, senior classification.
Interpretation and presentation of research data relating to crop science.

415. WORLD CROP RESOURCES.
(3-0) Cr. 3. F.W. Alt. SSI offered 1969.
Prerequisite: 114, Bot. 101 or 210.
Basic concepts of origin and adaptation of world crops. Production of cereal, oil fiber, sugar and other crop plants as affected by environmental conditions.

416. PRINCIPLES OF CROP PRODUCTION AND MANAGEMENT.
(10-0) Cr. 3. Off-campus.
Prerequisite: 114, Bot. 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.

424. 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 self and cross fertilizing species.

444. 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.

450. SPECIAL PROBLEMS.
Cr. arr. F.W.S.SS. Staff.
Open to qualified students, after consultation with professor in special area of interest. Selected studies in crops, soils, or climatology according to needs and interests of student. For foreign students, an analysis of soil, climatic and crop production resources of the student's home country is suggested.
H. Honors Program.

451. SEMINAR.
(1-0) Cr. 1. F.W.
Prerequisite: 310, senior classification.
Interpretation and presentation of research data relating to soil science.
453. FERTILIZERS.
(3-0) Cr. 3. F.
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.

455. PRINCIPLES OF SOIL FERTILITY, MANAGEMENT AND CONSERVATION.
(10-0) Cr. 3. Alt. SS. Offered 1969. 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.

457. 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.

464. SOIL EROSION AND CONSERVATION.
(2-3) Cr. 3. F.S.
Prerequisite: 354.

473. SOIL DEVELOPMENT AND CLASSIFICATION.
(3-3) Cr. 4. 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.

483. WORLD SOIL RESOURCES.
(2-3 or 2-0) Cr. 3 (2 cr. and no lab for students with credit in 154A or 357) Alt. W. Offered 1969.
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.

485. AGRO-MICROBIOLOGY.
(Bact. 485) (3-3) Cr. 4. S.
Prerequisite: 154, Bact. 300 or 304.

COURSES PRIMARILY FOR GRADUATE STUDENTS, major or minor, open to qualified undergraduates

305. PLANT CLIMATE
(3-0) Cr. 3. S
Prerequisite: 154, Bot. 310 Shaw
The heat exchange near the ground relation of topography and plant cover the micro-climate Modification of micro-climate by agricultural operations

306. METHODS IN CLIMATOLOGY
(3-0) Cr. 3; Alt S Offered 1968.
Prerequisite: 505, Stat. 448. Shaw.
Physical and statistical processes in the study of the climate and the analysis of agro-climatic data.

514. CROP ADAPTATION
(3-0) Cr. 3. F
Prerequisite: 114, Bot. 310, Gen 301, senior classification. Wilkie
Principles and concepts of origin, adaptation and distribution of crop plants (genetic and physiological aspects of plant response to environmental factors) Distribution of world crops on a climatic basis

518. ADVANCED CROP PRODUCTION
(3-0) Cr. 3. W
Prerequisite: 315 or 444 Woolley
Basic concepts in plant-soil-climate relationships with emphasis on recent advances in crop culture and management

524. PRINCIPLES OF PLANT BREEDING II.
(3-0) Cr 3 W.
Prerequisite: 424. Bot. 407 Atkins
Application of genetic principles to improvement of field crops. Topics covered include interspecific and intergeneric hybridization, induced polyploidy, induced mutations, sterility mechanisms, character inheritance and specific breeding considerations related to a spectrum of crop species

534. GRASSLAND IMPROVEMENT, MANAGEMENT AND EVALUATION.
(3-0) Cr. 3. W
Prerequisite: 315, 354. Wedin
Forage resources, ecology and dynamics. Principles of pasture management. Evaluation techniques in grassland research

550. SPECIAL TOPICS
Cr. arr. F W.S.SS.
Prerequisite: 15 Cr. in Agron. Staff.
Literature reviews and conferences on selected topics in crops, soils, or climatology according to needs and interest of student. For foreign students, an analysis of soil, climate, and crop production resources of the student's home country is suggested.

553. SOIL-PLANT RELATIONSHIPS
(3-0) Cr. 3. F.
Prerequisite: 354. Black
Composition and properties of soils in relation to the nutrition and growth of plants.

556. LABORATORY METHODS OF SOILS INVESTIGATIONS.
(0-4 to 6) Cr. 2 to 3. A: Alt. S. offered 1968: B: F.; C: W.

561. IRRIGATION AGRICULTURE.
(3-0) Cr. 3. Alt S. Offered 1968.
Prerequisite: 354. Troell
Properties of soils in relation to irrigation; use and quality of irrigation water; reclamation of saline and sodic soils; soil-plant-water relationships; management of irrigated cropland; irrigation in humid regions.
SOCIAL SCIENCE AND HUMANITIES

565. ADVANCED SOIL MANAGEMENT AND CONSERVATION.
(3-0) Cr. 3. Alt. W. Offered 1968.
Fundamental principles involved in the management, improvement and conservation of soils.

575. SOIL MORPHOLOGY, GENESIS AND CLASSIFICATION
(3-0) Cr. 3. W.
Prerequisite: 473, 553. Riecken.
Morphology and formation of soils, systems of classification, and geographical distribution of soils.

577. SOIL PHYSICS.
(3-0) Cr. 3. F.
Prerequisite: 354. Kirkham.
Relation of physical properties of soils to plant growth. Particle-size distribution, soil structure, clay minerals, soil moisture, rheological properties and soil temperature.

585. SOIL MICROBIOLOGY AND BIOCHEMISTRY.
(Bact. 585) (3-0) Cr. 3. W.
Prerequisite: 485, Frederick.
Nature of the microbiological population of the soil; activities of soil microorganisms; interactions between soil population and soil properties and plant growth; interpretation of biological data.

COURSES FOR GRADUATE STUDENTS, major or minor

600. SEMINAR.
(1-0) Cr. 1. F.W.S.
A Crops Carlson, Frey, Wilsie.
B Soils Black.
C Plant-Soil-Climatic Relationships. Shaw. Reports and discussions of recent literature and current investigations

605. RESEARCH IN AGRO-CLIMATOLOGY.
F.W.S.S.S. Shaw
Consultation with instructor, exhaustive examination of the literature pertaining to and original thought on a special research problem of special interest to the student

609 CONFERENCE IN AGRO-CLIMATOLOGY
(0-1) Cr. 1. F.W.S.S.S. Shaw.
Consultation with instructor, special problems and/or reading assigned in consultation with the instructor on which the student reports

615. ENVIRONMENTAL CROP PHYSIOLOGY.
(3-0) Cr. 3. S.
Prerequisite: Bot. 512. Shibbles.
The plant-environment interaction in relation to growth and production of crop communities.

623. CYTOGENETICS IN PLANT BREEDING.
(3-0) Cr. 3. F.
Prerequisite: 524, Gen. 401, Bot. 605. Peterson.
Cyto genetics in plant breeding. Topics include chromosome recombination, principles of chromosome pairing, distribution of genetic materials, aberrations, polyploids, genome relations, aneuploids, nullisomic analysis and interspecific hybrids

624. ADVANCED PLANT BREEDING I.
(3-0) Cr. 3. W.
Prerequisite: 524, Gen. 630. Russell.
Types of gene action in plant breeding. Topics include heritability, inbreeding depression and heterosis, development and evaluation of parental materials, prediction of hybrid performance. procedures and problems in testing for general and specific combining ability, factors limiting efficiency of selection and testing.

625 ADVANCED PLANT BREEDING II.
(3-0) Cr. 3. S.
Prerequisite: 524, 624, Gen. 630. Frey.
Relation of population structure to plant breeding. Topics include breeding systems, relation of population structure to inducing variability and to selection procedures; theory of pure lines, synthetic, and multiline varieties; importance of genetic shifts and homeostasis in plant breeding.

640. RESEARCH.
F.W.S.S.S.
A Crop Production and Physiology. 
B Plant Breeding and Cytogenetics.

655. ADVANCED SOIL FERTILITY.
(3-0) Cr. 3. Alt. W. Offered 1969.
Prerequisite: 553, Black.
Evaluation of soil fertility and fertilizers; theory and applications.

657. SOIL CHEMISTRY.
Prerequisite: 553, Chem. 484 or equivalent. Scott.
Chemical and mineralogical properties of soil colloids. Ion exchange and soil reaction.

675. ADVANCED SOIL GENESIS AND CLASSIFICATION.
(0-2) Cr. 2. Alt. S. Offered 1968.
Prerequisite: 575, Riecken.
Processes, reactions and theories in soil formation; principles of soil classification.

677. ADVANCED SOIL PHYSICS.
(Phys. 677) (3-0) Cr. 3. Alt. S. Offered 1969.
Prerequisite: 577, Math. 212. Kirkham.
Physical characteristics of soil and principles underlying flow and distribution of water in soils.

685. ADVANCED SOIL BIOCHEMISTRY.
(3-0) Cr. 3. Alt. S. Offered 1968.
Prerequisite: 585, Brenner.
Nature of soil organic matter, and biochemical transformations brought about by soil microorganisms.

690. RESEARCH.
F.W.S.S.S.
A Soil Microbiology and Biochemistry. 
(Bact. 690) (1) Brenner, (2) Frederick.
B Soil Fertility. (1) Hanway, (2) Pease, (3) Pierre.
C Soil Physics. (1) Kirkham.
E Soil Morphology and Genesis. (1) Riecken, (2) Ruhe, (3) Scholl.
F Soil Chemistry. (1) Black, (2) Brenner, (3) Scott.
ANIMAL SCIENCE

Leslie E. Johnson, Ph.D., Head of Department


Instructor: Roger E. Hunsley, M.S.

Opportunities for Undergraduate Study

For undergraduate curricula in animal science and dairy science, leading to the degree Bachelor of Science, see College of Agriculture, Curricula.

The curricula in animal science and dairy science provide training in the field of agriculture as applied to all phases of the production and distribution of livestock and livestock products. A liberal allowance of elective credits is permitted in each option of the curricula.

Students graduating from these curricula go into many lines of work. Men well trained in animal and dairy science are in demand as operators of livestock farms; directors of extension work; extension assistants in youth activities; fieldmen for farm management, banks and insurance companies; for management, buying, sales or supervisory positions with meat packing, produce, feed, merchandising, dairy and farm equipment companies; positions in the teaching field, and employment with various agencies of state and federal governments. Opportunities in college work in teaching, research, and extension usually require graduate training.

Opportunities for Graduate Study

The department offers major work for the degrees Master of Science and Doctor of Philosophy in breeding, meats, nutrition and reproduction. Advanced graduate study in meats is offered as a joint major in meat science and food technology. A Master of Science degree is offered in livestock production and dairy cattle production. Minor work is offered in breeding, meats, nutrition and reproduction to students with a major in other departments.

Graduate programs in animal science include supporting work in other areas such
as agronomy, anatomy, bacteriology, biochemistry, chemistry, dairy and food industry, genetics, physiology and statistics.

Prerequisite to major graduate work is the completion of an undergraduate program in animal science, dairy science and/or related sciences necessary for the pursuance of the chosen area in animal science. Basic courses in chemistry, mathematics and zoology are necessary in all animal science graduate work.

COURSES PRIMARILY FOR UNDERGRADUATE STUDENTS

110. ORIENTATION IN ANIMAL SCIENCE
     (1-0) Cr. R. F.W.S. SSI.
     Survey of animal science field.

114. ELEMENTS OF LIVESTOCK PRODUCTION.
     (3-2) Cr. 4. F.W.S. SSI.

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. and N. 107.
     Composition of meat and its nutritive value. Selection, grading, identifying, curing and freezing meats.

200. LIVESTOCK HUSBANDRY PRACTICES.
     (0-4) Cr. 2. F.S. SSI.
     Practical problems, demonstrations, participation in skills and practices encountered in the care, handling, and exhibiting of farm livestock. For special groups.

214. ECOSOLOGY AND APPRECIATION OF MEAT ANIMAL BREEDS.
     (2-2) Cr. 3. F.W.S.
     Prerequisite: 114. 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, sheep. Not accepted for credit for Animal and Dairy Science degrees.

235. DAIRY CATTLE PERFORMANCE.
     (2-2) Cr. 3. F.W.S. SSIII.
     Prerequisite: 114.

271. MEAT ANIMAL EVALUATION.
     (2-2) Cr. 3. F.W.S.
     Prerequisite: 170.
     Evaluation of meat animals, emphasis on growth and development and body composition. Grades and grading of meat.

305. LIVESTOCK JUDGING.
     (0-6) Cr. 3. F.
     Prerequisite: 214, 271. 115 recommended.
     Beef cattle, hogs, sheep and horses.

315. 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. Laboratory fee $10.

318. 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. SSI.
     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.

331. ANIMAL REPRODUCTION I.
     (3-2) Cr. 4. F.W.S.
     Prerequisite: V. Phys. 264 or Zool. 355.
     Physiology of reproduction in farm animals.

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 1969
B European Tour Offered 1968.
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. F.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. SSI. 68.
Prerequisite: 319, 350, 351 recommended.

429. SHEEP PRODUCTION AND MARKETING.
(2-2) Cr. 3. W.S.
Prerequisite: 319.

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: 370, Bact. 304, Chem. 231 or 335.
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 and 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.; D: Cr. 1-3. F.W.S.
Prerequisite: Permission of instructor.
A Meat animals and horses.
B Dairy cattle.
C Meats.
D Wool
Specialized training in evaluating and grading live animals, carcasses and wool. Field trips to farms, meat packing firms, wool marketing warehouses and livestock establishments.

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 quality point average of 2.5 or above for two preceding quarters. 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.
Not accepted for major credit toward M.S. or Ph.D. degree. The scientific method in animal research. Recognizing and defining important problems in the livestock industry. Emphasis upon planning and conducting animal experiments and interpretation of the observed results.

509. EVALUATION OF LIVESTOCK MANAGEMENT SYSTEMS.
(6-0) Cr. 3. S.
A critical appraisal of the factors, and their interrelationships, which contribute to the efficiency of various livestock management systems.

518. ADVANCED NON-RUMINANT NUTRITION.
(4-0) Cr. 4. W.
Nutrition requirements for maintenance, growth, fattening, reproduction and lactation in the non-ruminant animal.
519. ADVANCED RUMINANT NUTRITION I.
(3-0) Cr. 3. S.
Digestion, absorption and metabolism of nutrients as related to maintenance growth, lactation and reproduction in ruminants.

520. ADVANCED RUMINANT NUTRITION II.
(2-3) Cr. 3. Alt. F. Offered 1968.
Prerequisite: V. Phys. 462 or Zool. 552. McGillard.
Survey of outstanding literature on methodology as applied to the study of the physiological aspects of ruminant nutrition. Laboratory to illustrate principles, methods, and special procedures.

531. ANIMAL REPRODUCTION II.
(3-0) Cr. 3. F.S.
Prerequisite: 331. Anderson.
Endocrine aspects of animal reproduction.

550. GENETIC IMPROVEMENT OF FARM ANIMALS.
(3-0) Cr. 3. S.
Gene frequency, gene effects, genetic variation, and covariation in productive traits. Adjusting for environmental differences and estimated breeding value, mass, pedigree, family selection and progeny testing. Selection indices Breeding plans for maximizing rates of improvement. Not accepted for major credit toward M.S. or Ph.D. degree.

571. ADVANCED MEAT SCIENCE.
Prerequisites: 470 or permission of instructor. Goll, Parrish.
Role of chemical components of muscle on some fundamental properties and quality attributes of meat. Effect of post-mortem aging, processing, and storage on meat quality. Discussion of recent research topics.

590. SPECIAL TOPICS.
Cr. 1 to 3. F.W.S.
Special topics in the animal sciences, offered on demand and often conducted by guest professors.
A. Animal Breeding. Freeman, Hazel, Johnson, Willham.
D. Dairy Production. Foreman, Jacobson, Porter, Sims.

COURSES FOR GRADUATE STUDENTS, major or minor

603. SEMINAR IN ANIMAL NUTRITION AND MEATS.
(Po. Sci. 603) (1-0) Cr. 1. F.W.S.
Prerequisite: Permission of instructor.
Balloun, Burroughs, Jacobson, Speer.
Discussion of current literature; preparation and submission of abstracts.

605. METHODS AND TECHNIQUES IN ANIMAL NUTRITION EXPERIMENTATION.
(Po. Sci. 605) (2-3) Cr. 3. F.
Methods and techniques in planning and conducting nutrition experiments with poultry, swine, cattle and sheep. Includes visits to experimental facilities.

654. GENETICS OF BREED IMPROVEMENT.
( Gen. 654) (3-0) Cr. 3. W.
Genetic structure of breeds or other populations. Effects of gene number, degrees of dominance, gene interaction, linkage, mutations, non-genetic factors. Conditions of equilibrium. Rates of change in population mean, or variability. Effects of mass selection.

655. BREEDING SYSTEMS AND PLANS.
( Gen. 655) (3-0) Cr. 3. S.
Prerequisite: 654. Hazel.
Inbreeding and outbreeding, assortive mating, progeny testing, selection on family basis, selection indices, records of performance, methods of estimating heritability, comparison of various breeding plans.

670. MOLECULAR BIOLOGY OF MUSCLE.
(3-0) Cr. 3. Alt. F. Offered 1968.
Prerequisite: B. & B. 305 or 503 or permission of instructor. 470 recommended. Goll.
Microstructure, physical and chemical composition of muscle tissue. Chemistry of proteins. Chemical and physical aspects of muscle contraction and rigor mortis.

680 MODERN VIEWS OF NUTRITION.
( Po. Sci. 680, B. & B. 680, F. & N. 680) (2-0) Cr. 0. W.
A seminar presenting current concepts in nutrition and related fields. Required for all graduate students in nutrition.

690. RESEARCH.
A. Animal Breeding. Freeman, Hazel, Johnson, Willham.
D. Dairy Production. Foreman, Jacobson, Porter.
E. Meats. Goll, Kline, Topel.
F. Animal Reproduction L. Anderson, Melampy.
APPLIED ART

Marjorie S. Garfield, M.F.A., Head of Department


Associate Professors: Alice Davis, M.A.; Gladys E. Hamlin, M.A.; Shirley E. Held, M.S.; Neva M. Petersen, M.S.

Assistant Professors: June C. Brown, B.S.; Donna R. Danielson, M.S.; Ronald D. Fenimore, M.S.; Richard D. Heggen, M.F.A.; Emelda Kunau, B.S.


Opportunities for 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 in grades 7 through 14. Students may enroll in this major as sophomores but must apply to and be accepted by the departmental committee on selection and the University Committee on Teacher Education in order to advance to the teacher education program. For the teacher education program, including requirements for teaching certification, see Teacher 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.

Opportunities for Graduate Study

The department offers major work for the degree Master of Science in Applied Art and 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 Science 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, Home Management, Household Equipment and Landscape Architecture. For details consult the head of the department.

The department offers major work for the degree Master of Science 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.

Open to graduate students for minor only: 406, 424, 435, 445, 446, 464, 465, 484, 485, 486, 490.
COURSES PRIMARILY FOR UNDERGRADUATE STUDENTS

103. DESIGN I.  
(2-6) Cr. 4. F.W.S.SSI.SSI.SSI.  
Creative problems in design and color with emphasis on art elements and principles

104. DESIGN II.  
(0-9) Cr. 3. F.W.S.  
Prerequisite: 103.  
Two- and three-dimensional forms in design, varied materials and techniques

107. LETTERING I.  
(0-9) Cr. 3. F.W.S.  
Prerequisite: 103.  
Study of direct lettering and cut letters for display

150 DRAWING I.  
(0-9) Cr. 3. F.W.S.SSI.  
Prerequisite: 103.  
Freehand drawing and perspective in various media. A.A. majors should enroll by the fall quarter of the sophomore year for the teaching of arts and crafts in the elementary school

200. ART FOR THE ELEMENTARY SCHOOL  
(0-9) Cr. 3. F.S.  
Prerequisite: 103  
Experimentation with materials and processes in two and three dimensions suitable for teaching of arts and crafts in the elementary school

203. COLOR  
(2-3) Cr. 3. W.S.  
Prerequisite: 103  
Introduction to color theory and practical experiences in the laboratory

207. LETTERING II.  
(0-9) Cr. 3. F.  
Prerequisite: 107  
Advanced problems in letter design, techniques and methods

213. FASHION ILLUSTRATION I.  
(0-9) Cr. 3. W.S.  
Prerequisite: 150.  
Illustration of the fashion figure, costume rendering, layout

214. FASHION ILLUSTRATION II.  
(0-9) Cr. 3. F.  
Prerequisite: 213.  
Advanced work in rendering the costumed figure, accessories, layout

233 WATERCOLOR.  
(0-9) Cr. 3. F.W.S.SSI.  
Prerequisite: 150  
Experimentation with watercolor techniques as applied to still life and landscape

250. DRAWING II.  
(0-9) Cr. 3. W.S.  
Prerequisite: 150  
Study of composition and techniques in various media. Drawing of diversified subject matter

261 INTERIOR HOUSE DESIGN I.  
(1-6) Cr. 3. F.W.S.SSI.I.  
Prerequisite: 103.  
Principles of design and color applied to the exterior, interior and furnishings of the house

262. INTERIOR HOUSE DESIGN II.  
(0-9) Cr. 3. W.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 work in advertising design

324. FIGURE DRAWING.  
(0-9) Cr. 3. W.  
Prerequisite: 250.  
Artistic anatomy, figure drawing and portrait in various media

325. DRAWING III.  
(0-9) Cr. 3. F.S.  
Prerequisite: 250.  
Advanced Drawing

335. TEXTILE DESIGN I.  
(1-9) Cr. 4. F.W.S.SSI.SSI.  
Prerequisite: 104; for non-majors, 103.  
Creative design in block print, stencil, stitchery, batik, and silk-screen. Comparative analysis of designers and processes

344. WEAVING.  
(0-9) Cr. 3. F.W.S.SSI.SSI.  
Prerequisite: 104.  
Beginning weaving

345. WOOD AND METAL.  
(0-12) Cr. 4. F.W.S.SSI.SSI.  
Prerequisite: 104.  
Beginning metal and wood

361. HISTORY OF FURNITURE.  
(3-0) Cr. 3. F.W.  
A study of the history of furniture styles and interior architectural backgrounds

384. SURVEY OF ART.  
(3-0) Cr. 3. F.W.S.  
Survey of the art of all ages, emphasizing art as an expression of cultures

393. CERAMICS.  
(0-9) Cr. 3. F.W.S.  
Beginning ceramics

401. SENIOR STUDY TOUR.  
Cr. R.S.  
Prerequisites: A.A. senior classification, visit professional studios, retail establishments, art museums

404. SEMINAR.  
Cr. 1 or arr.  
Prerequisite: 12 Cr. in A.A.  
Art discussion

406. ADVERTISING DESIGN II.  
(0-9) Cr. 3. F.S.  
Prerequisite: 250, 306; Psych 250.  
Advanced work in advertising design

416. ART METHODS FOR THE SECONDARY SCHOOL.  
(3-0) Cr. 3. W.S.  
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 IN ART.  
Cr. 9. 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

424. OIL PAINTING.  
(0-9) Cr. 3. F.S.  
Prerequisite: 233; 250.  
Introduction to oil painting and new media
264 Description of Courses

435. TEXTILE DESIGN II
(0-9) Cr. 3. W.S.SSI.
Prerequisite: 335.
Varied media in textile design.

445. ADVANCED CRAFT DESIGN.
(0-9) Cr. 3. F.S.
Prerequisite: 344, 345.
Weaving, enamel, wood, metal, and other media.

446. JEWELRY.
(0-9) Cr. 3. W.S.
Prerequisite: 345.
Jewelry design

464. INTERIOR DESIGN I.
(1-6) Cr. 3. F.W.
Prerequisite: 233, 261.
Media for the interior designer. Fabric selections, room planning; interior renderings

465. INTERIOR DESIGN II.
(1-6) Cr. 3. W.S.
Prerequisite: 464.
Interior design, planning of a professional nature; budgeting

466. APPRENTICESHIP.
Cr. 9. S.SSI. following the junior year.
Prerequisite: 261, 335, 361, 384, 464, 465.
Practical interior design shop experience.

COURSES PRIMARILY FOR GRADUATE STUDENTS, for minor only, open to qualified undergraduates

535. TEXTILE DESIGN III.
(0-9) Cr. 3. S.SSI.
Prerequisite: 435.
Advanced textile design.

546. ADVANCED JEWELRY.
(0-9) Cr. 3. W.S.
Prerequisite: 446.
Advanced jewelry design

565. INTERIOR DESIGN III.
(1-6) Cr. 3. S.
Prerequisite: 465.
Advanced interior design

COURSES FOR GRADUATE STUDENTS, major or minor

590. ADVANCED DESIGN.
Cr. arr. F.W.S.SSI.
Prerequisite: B.S. in A.A. or satisfactory evidence of ability.
A Painting and Composition Adams, Meixner.
B Textile Design Clara, Navin.
C Craft Design Held, Rogers.
D Ceramics Staff.
E Interior Design Dawn, Garfield, Navin.
F Advertising Design. Fenimore.
G Fashion Illustration. Danielson, Meixner.

605. SEMINAR.
Cr. arr. F.W.S. Garfield.

614. RESEARCH.
F.W.S.SSI.SSI. Garfield.

ARCHITECTURE

Raymond D. Reed, M.Arch., Head of Department

Professors: Karol J. Kocimski, M.Arch., Roscoe O. Lorenz, M.S.; Lawton M. Patten, B.Arch.; Vernon F. Stone, B.Arch.
Associate Professors: Arthur E. Burton, M.S.; Tadeus M. Janowski, M.Arch.; Thomas C. Jellinger, M.S.; Donald I. McKeown, M.S.; Bernard J. Slater, M.S.
Instructors: James E. Brewer, B.Arch.; Ernst A. Ibs, M.Arch.; Donald E. Kawal, M.S.; William P. Stamm, M.Arch.; Donald F. Wheeler, M.Arch.
Opportunities for Undergraduate Study

The architect seeks to create an environment that encourages the growth of meaningful human values. The basic curriculum in architecture with concentrations in construction, visual design, planning, structures and other approved studies relevant to architecture leads to the degree Bachelor of Architecture, and provides the academic foundation for a professional career in accordance with registration laws of the various state's. Practical experience in approved architectural or construction firms is required prior to graduation.

Courses listed under *Architectural Engineering* are provided for students completing work for the degree Bachelor of Architectural Engineering. This degree is being terminated and is not available to students matriculating under this catalog.

A curriculum is provided for those who are interested in building construction. This program leads to the degree Bachelor of Science in Building Construction. For particulars, consult the Head of the Department of Architecture. See description of courses under *Building Construction*.

In cooperation with the Department of Industrial Administration, a program of study is provided for those interested in the business of building and related industries. This program leads to the degree of Bachelor of Science with a major in industrial administration and a minor in architecture. For information, consult the head of either department.

Opportunities for Graduate Study

The department offers major work for the degree Master of Architecture to those candidates interested in research and/or design and analysis. Satisfactory completion of a curriculum equivalent to the undergraduate architecture program of this institution is prerequisite to major graduate work. Minor work is offered to students majoring in other disciplines. A minimum of 36 credits must be taken while in residence. A minimum of 45 credits including a graduate thesis or 54 credits not including a thesis is required for graduation.

The foreign language requirement for the degree Master of Architecture may be waived upon recommendation of the head of the department.

Open to graduate students for minor only: Arch. 345, 346, 355, 371, 372, 373, 441, 442, 480, 543.

For students interested in interdisciplinary study of housing a program is administered in cooperation with the Departments of Applied Art, Architecture, Home Management, Household Equipment and Landscape Architecture. For details consult the head of the department.

COURSES PRIMARILY FOR UNDERGRADUATE STUDENTS

101, 102, 103. SEMINAR.
(1-0) Cr. 1 each. Yr. SS.
Synthesis, orientation, seminar discussions and lectures, field trips, visiting critics, projects of timely interest and computation methods

111, 112, 113. DESIGN I
(0-6) Cr. 2 each. Yr.
Analysis of designed objects Individual and group projects in perception of human requirements and reactions. Studies in relative time, motion and spatial sequences and relationships. Design methodology is stressed.

121, 122, 123. HISTORY OF ARCHITECTURE AND THE RELATED ARTS I.
(3-0) Cr. 3 each. Yr. SS.
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.

201, 202, 203. SEMINAR.
(1-0) Cr. 1 each. Yr. SS.
Prerequisite: Second year classification. Synthesis, professional orientation, seminar discussions and lectures, field trips, visiting critics, special projects of timely interest

211, 212, 213. DESIGN II.
(0-9) Cr. 3. each. Yr.
Prerequisite: 113, E.Gr. 143. Credit or classification in Math. 112. For LA students only: L.A. 113, E.Gr. 143.
Projects in elementary architectural design. Introduction and functional integration of structural concepts, planning and circulation. Recognition and synthesis of objective and subjective values. Problem methodology is stressed.
266 Description of Courses

221. 222, 223. HISTORY OF ARCHITECTURE AND THE RELATED ARTS II
   (3-0) Cr. 3 each. Yr.SS
   Prerequisite: 123.
   A study of architecture and the related arts since the development of the modern movement.

231. DRAWING I.
   (0-6) Cr. 2. F.W.S.S.
   Beginning drawing and sketching in pencil and charcoal. Study of proportion, perspective and form

232. DRAWING II.
   (0-6) Cr. 2. W.S.S.
   Prerequisite: 231.
   Freehand drawing, various media

233. DRAWING III.
   (0-6) Cr. 2. S.SS.
   Prerequisite: 232
   Freehand drawing, extended to color theory and water color

241. ANALYSIS OF MATERIALS AND METHODS OF CONSTRUCTION
   (3-0) Cr. 3. F.
   Prerequisite: Second year classification or approval of the Head of the Department of Architecture.
   Systems of building construction including wood frame, wall bearing, skeleton frame, and the building materials used in these systems

301, 302, 303. SEMINAR
   (0-1) Cr. 1 each. Yr.SS.
   Prerequisite: Third year classification.
   Synthesis, professional orientation, discussions and lectures, field trips, visiting critics, projects of timely interest

311, 312, 313. DESIGN III
   (0-12) Cr. 4 each. Yr.SS.
   Prerequisite: 213, credit or classification in Phys. 223, E.M. 324.
   Individual and group projects of intermediate architectural scope. Economic, technical, regional, and sociometric variables. Field trips

319. SUMMER WORK.
   Cr. R. SS
   Ten weeks of practical experience with an approved architectural or construction firm

331, 332, 333. ARCHITECTURAL DELINEATION
   (0-9) Cr. 2 each. Yr.SS.
   Prerequisite: 231 or 343.
   Specification, interpretation of architectural specifications and other contract documents

342. 343. MATERIALS AND METHODS OF ARCHITECTURAL CONSTRUCTION.
   (0-9) Cr. 3 each. 342: W. 343: S.
   Prerequisite: 342: E.M. 337, E.M. 354; 343: 342.
   Properties of materials used in architectural construction. Manufactured, site-assembled or built-in-place assemblies. Techniques of architectural construction. Coordination of construction trades. Preparation of construction and contract drawings

345. SPECIFICATIONS.
   (2-0) Cr. 2. W.
   Prerequisite: 241 or 343.
   Preparation and interpretation of architectural specifications and other contract documents

346. CONSTRUCTION COST ESTIMATING.
   (2-3) Cr. 3. S.
   Prerequisite: 345.
   Estimating building construction costs, quantity surveys, production rates, local cost factors. Approximate and detailed methods

347. CERAMIC CONSTRUCTION MATERIALS.
   (Cer. E. 347) See Ceramic Engineering.

355. REAL ESTATE FINANCE.
   (1.Ad. 355) See Industrial Administration.

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, 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, political factors.

371. BUILDING CONTRACTORS ORGANIZATION.
   (3-0) Cr. 3. F.
   Prerequisite: 346, credit or classification in I.E. 351.
   Construction contracting business management: planning, organization, staffing, directing, controlling.

372. CONSTRUCTION PROGRESS SCHEDULING I.
   (0-9) Cr. 3. W.
   Prerequisite: 371.
   Types of progress schedules used in construction work. Applications and advantages of types of schedules.

373. SITE ORGANIZATION AND INSPECTION OF CONSTRUCTION.
   (1-6) Cr. 3. S.
   Prerequisite: 371.
   Principles of planning construction site layouts. Methods and equipment used in field inspection of construction.

401, 402, 403. SEMINAR.
   (1-0) Cr. 1 each. Yr.SS.
   Prerequisite: Fourth year classification.
   Synthesis, professional orientation, seminar discussion and lectures. Field trips, visiting critics, projects of timely interest.

411, 412, 413. DESIGN IV.
   (0-15) Cr. 5 each. Yr.SS.
   Prerequisite: 313, credit or classification in C.E. 433A.
   Complex urban architectural design problems. Field trips.

419. SUMMER WORK.
   Cr. R. SS.
   Ten weeks practical experience with an approved architectural or construction firm.

430. ADVANCED FREEHAND DRAWING.
   (0-6) Cr. 2 each term elected. F.W.S.S.
   Prerequisite: 4 credits in freehand drawing.
   A. Charcoal and crayon.
   B. Pencil.
   C. Color.
   D. Pen and ink.
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. DESIGN OF ARCHITECTURAL STRUCTURAL SYSTEMS.
(1-3) Cr. 2 each time elected. F.W.S.S.
Prerequisite: C.E. 434A, 313.
Design and comparative analysis of architectural structural systems.

460. SPECIAL PROBLEMS IN ARCHITECTURE.
(0-6 to 27) Cr. 2 to 9. F.W.S.S.
Prerequisite: Fourth or fifth year classification, permission of department head.
Investigation of problems of special interest to the student.

480. SPECIAL PROBLEMS IN BUILDING CONSTRUCTION.
Cr. 2 to 5 each time taken.
Prerequisite: 345, 373, permission of department head.
Advanced problems in building construction with emphasis in the field of construction operations and in the field of engineering and technology.

COURSES PRIMARILY FOR GRADUATE STUDENTS, major or minor, open to qualified undergraduates

590 SPECIAL TOPICS.
Cr. 2 to 5 each time elected. F.W.S.S.
Prerequisite: Permission of department head.
The solution of theoretical and practical problems in architecture and related design areas.

COURSES FOR GRADUATE STUDENTS, major or minor

601, 602, 603. SEMINAR.
(1-0) Cr. 1 each. Yr.SS.
Prerequisite: Graduate student classification.
Professional orientation, seminar discussions and lectures. Field trips, visiting lecturers and critics, special projects of timely interest.

610. ARCHITECTURAL RESEARCH AND/OR DESIGN AND ANALYSIS.
Cr. 3 to 12. F.W.S.S.
Prerequisite: Graduate student classification.
An approved research or design subject. A minimum of 24 credits in 610 including a thesis, or a minimum of 33 credits in 610 not including a thesis, is required for graduation.

BACTERIOLOGY

William R. Lockhart, Ph.D., Chairman of Department

Professors: John C. Ayres, Ph.D.; Robert E. Buchanan, Ph.D.; Lloyd R. Frederick, Ph.D.; Paul A. Hartman, Ph.D.; Max Levine, Ph.D.; (Emeritus); Loyd Y. Quinn, Ph.D.

Associate Professors: Russell J. Beers, Ph.D.; Peter A. Pattee, Ph.D.; George W. Reinbold, Ph.D.; Homer W. Walker, Ph.D.

Assistant Professors: John G. Holt, Ph.D., Fred D. Williams, Ph.D.
Opportunities for 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 organization, 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, 300, 325, 375, 404, 413, 436. The following courses are desirable as supporting work: Chem. 211, 334, 335, 336; Phys. 111, 112, 113; Math. 110; Stat. 201, Zool. 101, 102; Bot. 202; 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.

Opportunities for 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.

Open to graduate students for minor only 350, 375, 412, 413, 414, 436, 450, 485.

COURSES PRIMARILY FOR UNDERGRADUATE STUDENTS

200 INTRODUCTORY BACTERIOLOGY I
(3-0) Cr. 3. F.W.S
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
(2-4) Cr. 3. W.S
Prerequisite: 200; Chem. 231 or 334
Study and cultivation of bacteria, laboratory methods in bacteriology

304 GENERAL BACTERIOLOGY
(3-6) Cr. 5. F.W.S
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.

325 ADVANCED GENERAL BACTERIOLOGY
(3-6) Cr. 5. S.
Prerequisite: 300 or 304
Intermediate morphology, cytology, and physiology of microorganisms

350. DAIRY MICROBIOLOGY.

375. PATHOGENIC BACTERIA.
(3-6) Cr. 5. F.
Prerequisite: 300 or 304
Study of pathogenic bacteria, infection and immunity in diseases of man, animals and plants, prevention and control of infectious diseases

404. SPECIAL PROBLEMS.
Cr. 1 to 5 F.W.S.
Prerequisite: Permission of department head.
11 Honors Program

412. FOOD PRESERVATION.
(D.F.I. 412) See Dairy and Food Industry
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.

COURSES PRIMARILY FOR GRADUATE STUDENTS, major or minor, open to qualified undergraduates

501. BACTERIOLOGICAL TECHNIQUES
(3-6) Cr. 5. F.
Prerequisite: 325.
Study of function and structure of bacteria, research methods, literature survey and professional orientation in bacteriology.

509. GENERAL VIROLOGY
(Bot. 509, Vet. Hyg. 509)
(3-0) Cr. 3. W.
Prerequisite: Permission of instructor.
Grazek, Horton, Pattee.
A study of the principles of bacterial, plant, and animal viruses with special reference to morphology, physical-chemical properties, multiplication, and host responses.

525. APPLIED MICROBIOLOGY
(3-0) Cr. 3. F.
Prerequisite: 300 or 304. Beers.
Utilization of microorganisms in agriculture and industry.

531. BACTERIAL VIRUSES
(3-6) Cr. 5. S.
Prerequisite: 509. Pattee.
Function and structure of bacterial viruses, host-virus interactions.

COURSES FOR GRADUATE STUDENTS, major or minor

620. BIOCHEMICAL GENETICS.
( Gen. 620) See Genetics.

621. BACTERIAL GENETICS.
( Gen. 621) (2-4) Cr. 3. F.
Prerequisite: 501. Pattee.
Isolation, characterization and uses of mutant bacteria, mechanisms of genetic exchange and their application to genetic and biochemical analysis of bacteria.

631, 632, 633. PHYSIOLOGY OF BACTERIA.
(3-0 or 6) Cr. 3 or 5. Yr. Lockhart, Williams.
631 Influence of chemical and physical environment on bacteria, bacterial nutrition.
632 Bacterial Metabolism, functions of intermediary catalysts.
633 Selected topics of current interest.

656 SYSTEMATIC DAIRY MICROBIOLOGY.

690. RESEARCH.
Staff.

698. SEMINAR IN CELL BIOLOGY

BIOCHEMISTRY AND BIOPHYSICS

Dexter French, Ph.D., Chairman of Department

Description of Courses


Assistant Professors: Darryll E. Outka, Ph.D.; Carl L. Tipton, Ph.D.

Instructor: Deane R. Clark, M.S.

Opportunities for 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. 401 (or 501, 502, 503), 461, 511; Chem. 102A, 103 (or 107, 108), 214, 215, 224, 237, 316, 325, 326, 327, 330, 331, 332, 333; Math. 110, 111, 112, 213; Phys. 221, 222, 223, Zool. 101, 102, 355 or Bot. 101, 202, 310; Bact. 304; Gen. 301.

Biophysicists usually include the following basic courses in their programs. B. & B. 461; Phys. 221, 222, 223, 314, 421, 422, 423, 496; Math. 110, 111, 112, 213, 321, 322, 323; Chem. 102A, 103 (or 107, 108) 211, 321, 322, 323, 334, 335; Zool. 101, 102, 355, or Bot. 101, 202, 310; Gen 301.

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.

Opportunities for 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, 315, 347, 348, 349, 401, 461, 490.

COURSES PRIMARILY FOR UNDERGRADUATE STUDENTS

301. BIOCHEMISTRY.
(3-0) Cr. 3. F.W.S.
Prerequisite: Chem. 231.
Chemical composition and reactions of living matter. 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.
**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. Graves, Herrn, Horowitz, Metzler, Tipton.
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

(1-6) Cr. 3 each 511: F.W. 512: S
Taken in conjunction with 501, 502, 503

### 521. RADIOBIOCHEMISTRY

(1-6) Cr. 3. S
Prerequisite: Chem 426, permission of instructor. Aronoff.
The use of radiotopes 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, 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. F.
Prerequisite: Math. 111, Phys. 113 or 223. Roth.
Optical microscopy including phase and interference techniques. Principles of electron optics. Methods and applications of electron microscopy.

### 575. LABORATORY IN MICROSCOPY.

(6-0) Cr. 2. F.W.S.
Prerequisite: 574. Roth.

### 578. BIOLOGICAL FINE STRUCTURE

(3-0) Cr. 3. W.
Prerequisite: 505 or 501 and Bot. 504 or Zool. 528 or V.Anat. 103 and consent of instructor. Roth.
An advanced study of the cell as a functional unit and of related information obtained by numerous techniques applied at the near-chemical level of structure. In addition to a general treatment, a selected topic of current interest will be developed each year.
272 Description of Courses

581. 582. SEMINAR.
(1-0) Cr. 1 each. F.W.
Prerequisite: Permission of instructor.
Short talks and discussion by students on assigned topics. Designed especially for entering graduate students and qualified seniors.

590 SPECIAL TOPICS.
Cr. arr.
X Physical Chemistry of Macromolecules.
S. 1968

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. Staff.
A series of one-semester courses covering such topics as enzymes, hormones, lipids, nucleic acids, proteins, vitamins, biochemistry of diseases, immunohemistry, and biochemical methods.

622 CARBOHYDRATE CHEMISTRY
(3-0) Cr. 3 SS. French.
Prerequisite: Permission of instructor. Chemical behavior and enzyme relationships of sugars and poly saccharides.

623. LIPID CHEMISTRY.
(D.F.I. 623) (3-0) Cr. 3. Alt. F. Offered 1968.
Prerequisite: 501 Hammond.
The chemistry of fatty acids, glycerides, complex lipids, waxes, sterols, and minor lipids.

661. ADVANCED BIOPHYSICS.
(3-0) Cr. 3 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.

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.

*Offered by the College of Agriculture. Courses not marked by an asterisk are offered by the College of Sciences and Humanities.

BIOLOGY

Biology encompasses a number of departments at Iowa State University. Basic undergraduate and graduate courses, and research opportunities in the biological sciences are offered in the Departments of Bacteriology, Biochemistry and Biophysics, Botany and Plant Pathology, Genetics and Zoology and Entomology. Proper selection of courses from these departments and appropriate choices in mathematics, physics, and chemistry, provide an excellent foundation for an understanding of biological phenomena, concepts, and methods of investigation. 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 majors in biomedical engineering, dairy science, farm crops, and fisheries and wildlife biology provide undergraduate and graduate instruction and research programs in applied and specialized phases of the biological sciences.

An interdepartmental, undergraduate, two-quarter sequence of courses in biology. Science 101 and 102, is offered. See Science.

An interdepartmental graduate program in cell biology is also available.

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.
**Associate Professors:** D. Dale Gillette, D.V.M., Ph.D.; Morris H. Mericle, Ph.D.; Allan G. Potter, Ph.D.; Richard C. Seagrave, Ph.D.; Charles R. Townsend, Ph.D.

**Assistant Professors:** William H. Brockman, Ph.D.; David L. Carlson, Ph.D.; Richard L. Engen, Ph.D.; Frank T. Koide, Ph.D.

**Instructor:** Curran S. Swift, 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 such as central nervous system memory and biological sensors, 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.

**Opportunities for 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, electrical engineering and physics.

**Opportunities for Graduate Study**

Graduate students who elect training in biomedical engineering ordinarily will select, depending upon their previous education, either an engineering or a life science field for an academic major, with biomedical engineering as a minor subject field in the graduate degree program. This option may be chosen at both the M.S. and Ph.D. levels.

For the degree Master of Science with a minor in biomedical engineering the following courses plus prerequisites are normally required for an individual with engineering background: B & B 304, 305, or equivalent; V.Anat. 513; V.Phys. 514, 515; E.E. 572.

An individual with a background in a life science area would normally be required to take E.E. 441, 445, and 446; E.M. 420, V.Anat. 513 (1 cr.), V.Phys. 514 and 515 (1 cr. each), E.E. 572 and their prerequisites.

For the degree Doctor of Philosophy with a minor in biomedical engineering, the requirements for related coursework will be formulated by the student's graduate committee and would normally include E.E. 571 and 671 or E.M. 420 and 620, in addition to appropriate coursework suggested for the M.S. degree.
274 Description of Courses

Research topics for thesis requirements may be taken in Biomedical Engineering at both the Master of Science and Doctor of Philosophy levels. Laboratory facilities are available in the Biomedical Engineering building.

BOTANY AND PLANT PATHOLOGY

Frederick G. Smith, Ph.D., Head of Department


Assistant Professor: George Knaphus, Ph.D.;

Opportunities for 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, Curriculum.

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 basic courses: 101 or 210, 105, 202, 306, 310, 404, 407, and 424, supplemented with others from the following: 203, 216, 301, 304, 338, 399, 438, 500, 501, 502, 503, 504, 506, 564. Undergraduate minor programs and supporting courses usually include: Bact. 304; B. & B. 301; Chem. 101, 102, 103, 211, 334, 335; Gen. 301; Geol. 100; Math. 101, 102, 110; Phys. 111, 112, 113; Zool. 101, 102, 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.

Opportunities for Graduate Study

The department offers major work for the degrees Master of Science and Doctor of Philosophy in cytology and cytogenetics, plant ecology, morphology, mycology, pathology, phycology, physiology, taxonomy, and economic botany, 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. 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 in Botany

COURSES PRIMARILY FOR UNDERGRADUATE STUDENTS

101. GENERAL BOTANY.
(2-4) Cr. 4. F.W.SSI, SSII.
Biology of seed plants: metabolism, development and reproduction from the molecular to the organismal levels. 105 may be elected concurrently

105. CONCEPTS IN PLANT SCIENCE.
(1-0) Cr. 1. F.W.S.
Prerequisite: Concurrent classification in 101 or 210.
Appraisals of major concepts and ideas influencing the development of plant science. Sample topics include cell theory, molecular basis of inheritance, evolution, environmental cycles, plant societies, photosynthesis, plant growth regulators, parasitism.

*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. 3-5.
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 305 are recorded.

202. THE PLANT KINGDOM.
(2-4) Cr. 4. W.SSI, SSIII.
Prerequisite: 101.
Nature and possible evolutionary relationships of the major groups of plants.

203. FIELD BOTANY.
(0-6) Cr. 3. SSSI, SSIII.
Prerequisite: 210 or credit or classification in 202.
Field and laboratory study of plants in various local habitats. Introduction to use of keys and basic ecological concepts. Field trips.

210. INTRODUCTION TO PLANT SCIENCE.
(3-4) Cr. 5. S.
A synthesis of 101 and 202 in which representatives of major groups are used to illustrate the structure, growth, reproduction, and evolutionary relationships of plants. Botany 105 may be elected concurrently. Credit toward graduation not allowed for both 101 and 210.

216. WEED IDENTIFICATION AND CONTROL.
(2-6) Cr. 4. F.
Prerequisite: 101 or 210.

301. FIELD BIOLOGY.
Cr. 4. SSI. (Lakeside Lab.)
A study of plants in natural environments; includes methods of identification, collection, and preservation as well as basic ecological concepts. Field trips. May be taken at Iowa Lakeside Laboratory concurrently with Zool. 302.

304. BOTANY OF ECONOMIC PLANTS.
(3-2) C. 4. W.
Prerequisite: 101 or 210.
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: 101 or 210.
Principles of classification of seed plants; survey of major plant families, identification and field study of local plants. Field trips. May be taken for 7 or 8 credits at Iowa Lakeside Laboratory.

310. ELEMENTARY PLANT PHYSIOLOGY.
A: (2-4) Cr. 4. F.W.SSI.
Prerequisite: 101 or 210, Chem. 102.
Principles of absorption, conduction, transpiration, photosynthesis, respiration, growth, and reproduction. B sections are required for majors and available to other students desiring more extensive laboratory work.

338. SEED ANALYSIS.
(1-4) Cr. 3. Alt. W. Offered 1969.
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.
DENDROLOGY.  
(For. 356) (2-6) Cr. 4. F.  
Prerequisite: 306.  
Families, genera, and species of North American trees; angiosperms and gymnosperms. Field trips.

UNDERGRADUATE SEMINAR.  
(1-0) Cr. 1 each time elected. W.  
Prerequisite: Junior classification.  
Meetings of students and staff to discuss topics of current interest in plant science.

PLANT ANATOMY.  
(2-4) Cr. 4. F.W.S. Alt. SSI offered 1969.  
Prerequisite: 9 Cr. In Bot.  
Structure of vegetative and reproductive organs of vascular plants; derivation, external form, positional relationships and anatomy of organs

PRINCIPLES OF PLANT PATHOLOGY.  
(2-4) Cr. 4. W.S.  
Prerequisite: 202 or 210, 310.  
Principles underlying the nature and control of plant diseases.

FUNDAMENTALS OF BOTANY.  
(3-6) Cr. 5. S.  
Prerequisite: 15 credits in biological 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.

FOREST PATHOLOGY.  
(For. 416) (2-6) Cr. 4. S.  
Prerequisite: 202 or 210, 310.  
Nature and control of forest and shade tree diseases. Weekend field trips in northern and eastern Iowa.

WOOD DETERIORATION.  
(For. 417) (2-6) Cr. 4. W.  
Prerequisite: 202 or 210, 310.

Courses primarily for graduate students, major or minor, open to qualified undergraduates

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 freshwater algae of the midwest. Field trips. May be taken for 7 or 8 credits at Iowa Lakeside Laboratory.

BRYOLOGY.  
(2-3) Cr. 3. Alt. W. Offered 1969.  
Prerequisite: 15 credits in biological science.  
Lersten.  
Morphological features and possible relationships of mosses and liverworts. Field trips. May be taken for 7 or 8 credits at Iowa Lakeside Laboratory.

LOWER VASCULAR PLANTS.  
(3-3) Cr. 4. S.  
Prerequisite: 15 credits in biological science.  
Mickel.  
Morphological features and possible relationships of psilophytes, club-mosses, horsetails, and ferns. Field trips.

HIGHER VASCULAR PLANTS.  
(2-6) Cr. 4. Alt. W. Offered 1968.  
Prerequisite: 15 credits in biological science.  
Lersten.  
Morphological features, primarily those associated with reproduction, of gymnosperms and angiosperms. Nature of cones and flowers in relation to phylogeny possible origin of angiosperms.

PLANT CYTOLOGY.  
(3-3) Cr. 4. F.  
Prerequisite: 6 credits in biological science.  
Gen. 301; Chem. 355 recommended. Bowen.  
The anatomy and physiology of cytoplasm and nucleus. Cell division and the role of the cell in reproduction.

PRINCIPLES OF MYCOLOGY.  
(3-3) Cr. 4. F.  
Prerequisite: 15 credits in biological science.  
Tiffany.  
Morphology, cytology and physiology of fungi, their relation to agriculture and industry.

GENERAL VIROLOGY.  
(see Bact. 509)

PLANT PHYSIOLOGY.  
(3-0) Cr. 3 each. F.W.S.  
Prerequisite: 310, Chem. 211, 335. Loomis.
Water relations of plants, minerals and organic nutrition. Physiology of growth and reproduction.

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.
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.

Prerequisite: 571. Buchholtz.
Exclusion, eradication, protection and disease resistance as means of control or prevention of plant disease.

*536. METHODS OF RESEARCH IN PLANT PATHOLOGY. (2-6) Cr. 4. Alt. F. Offered 1966.
Prerequisite: 571 or 572 or 573. Foley. Introduction to the theory and practice of research in plant pathology.

555. BOTANICAL MICROTECHNIQUES. (1-6) Cr. 3. F. Alt. SSI. 1968.
Prerequisite: 310. Lersten, Sass.
Methods of killing, imbedding, sectioning, and staining plant material. Methods of studying and recording microscopic preparations; microscopy, micrometry, projection, photomicrography.

556. ADVANCED PLANT ANATOMY. (2-4) Cr. 4. W.
Prerequisite: 310, 404. Sass.
Origin, development and structure of tissue systems of vegetative and reproductive organs of vascular plants.

558. PALEOBOTANY. (2-3) Cr. 3. Alt. W. Offered 1968.
Prerequisite: Permission of instructor. Mickel.
Introduction to the morphology, relationships, and identification of fossil plants. Field trips.

564. AQUATIC PLANTS. (2-3 or 2-6) Cr. 3 or 4. F.
Prerequisite: 306, permission of instructor. Taxonomy, ecology and morphological specializations of aquatic plants, with emphasis on vascular plants. Field trips. May be taken for 7 or 8 credits at Iowa Lakeside Laboratory.

*571. ADVANCED PLANT PATHOLOGY. (2-3) Cr. 3. F.
Prerequisite: 407 or 416 or 417. Buchholtz.
Diseases of field and horticultural crops caused by phycomycetes and ascomycetes.

*572. ADVANCED PLANT PATHOLOGY. (2-3) Cr. 3. W.
Prerequisite: 407 or 416 or 417. Dunleavy.
Diseases of field and horticultural crops caused by bacteria.

COURSES FOR GRADUATE STUDENTS, major or minor

605. CYTOGENETICS. (Gen. 605) (3-0) Cr. 3. W.
Prerequisite: 504 or Zool. 528, Gen. 401.

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*573. ADVANCED PLANT PATHOLOGY. (2-3) Cr. 3. F.
Prerequisite: 571, Gen. 301, Browning.
Diseases of field and horticultural crops caused by smut and rust fungi.

*574. PLANT DISEASES CAUSED BY NEMATODES. (3-3) Cr. 4. F.
Prerequisite: 407 or 416 or 417. Norton.
Symptoms of plant diseases caused by nematodes, host-parasite relationships, interactions, etiology and disease control.

575. FIELD MYCOLOGY. (2-12) Cr. 4. SSI. 1969. (SSII. 1968. Lakeside Lab.)
Prerequisite: 9 credits in Bot. 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 7 or 8 credits at Iowa Lakeside Laboratory.

*576. FIELD PLANT PATHOLOGY. (2-3) Cr. 3. Alt. SSII. Offered 1968.
Prerequisite: 407 or 416 or 417. Buchholtz.
Techniques and interpretation of field plots; plant disease surveys and estimates of prevalence and severity. Field trips.

*577. ADVANCED FOREST PATHOLOGY. (For. 577) (2-3) Cr. 3. Alt. F. Offered 1966.
Prerequisite: 416, McNabb.
Principles of pathology in forest practice illustrated by specific forest tree disease problems. Four-day field trip to a forest pathology research center.

579. SPECIAL TOPICS. Cr. 2 to 5 each time elected. F.W.S.
Prerequisite: 15 credits in Bot., permission of instructor.
A Morphology. Dodd, Lersten, Mickel, Sass.
B Physiology. LaMotte, Loomis, Smith, Staniforth.
D. Mycology. Tiffany.
E. Taxonomy. Isely, Pohl.
F. Plant Ecology. Landers.

584. ADVANCED PLANT ECOLOGY. (2-3) Cr. 3. F.
Prerequisite: 424, Landers.
Origin, development and reactions of vegetation; classification of vegetation units; plant indicators. Field trips.

595. AGROSTOLOGY. (1-6) Cr. 3. 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.

Bowen.
A continuation of 504 dealing with those aspects of the cell which directly affect inheritance and evolution.
278 Description of Courses

624. PHYSIOLOGY OF FUNGI. (3-0) Cr. 3. Alt. W. Offered 1968.
Prerequisite: 506. Smith.
Special physiology of fungi; nutrition, metabolism, growth and toxicology.

625. HOST-PARASITE INTERACTIONS. (2-0) Cr. 3. Alt. S. Offered 1967.
Prerequisite: 9 graduate course credits in pathology or mycology. Buchholtz.
Phenomena of infection and response in plants parasitized by fungi, bacteria and viruses.

641, 642, 643. GENERAL MYCOLOGY. (2-6) Cr. 4 each. Yr.
Prerequisite: 407 or 416 or 417. Tiffany.
Taxonomy, morphology and phylogeny of slime molds and fungi (phycomyctes, ascomycetes, fungi imperfecti, and basidio- myctes).

644. PLANT VIROLOGY. (2-3) Cr. 3. S.
Prerequisite: 509. Ford.
Plant-virus interactions; function, structure, replication, identification, biochemistry of plant viruses and resultant diseases.

646. ANIMAL MYCOLOGY. (0-6) Cr. 3. Alt. W. Offered 1968.
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. SSI. Bowen.
Prerequisite: B & B 574.
This course is parallel to B & B 575, but deals primarily with preparation and observations of plant materials.

690. ADVANCED PLANT TAXONOMY. (2-6) Cr. 3. S.
Prerequisite: 306. Pohl.
Principles of plant classification, bibliographic tools of systematic botany; methods of collection, preservation and study of vascular plants.

Prerequisite: 306. Isely.
Classification, evolution and identification of legumes. Emphasis on major taxonomic groups and those of economic significance.

695. RESEARCH.
A. Morphology. Dodd, Mickel, Sass.
B. Physiology. LaMotte, Loomis, Smith, Staniforth.
D. Mycology. Tiffany.
E. Taxonomy. Isely, Pohl.
F. Plant Ecology. Landers.

698. SEMINAR.
Meetings of botanical staff and students to discuss recent literature and problems under investigation.
A. Cr. 1. F.S. Dodd, Isely, Mickel, Pohl, Sass.
For students taking major work in morphology and taxonomy.
B. Cr. 1. F.S. LaMotte, Landers, Loomis, Smith, Staniforth.
For students taking major work in physiology and ecology.
* C. Cr. 1. F.S. Browning, Buchholtz, Dunleavy, McNabb, Norton, Simons, Smith, Tiffany, Wallin.
For students taking major work in plant pathology.
D. Cr. 1. W.
For all staff and students in Botany and Plant Pathology.
* Administered by the College of Agriculture. Courses not marked by an asterisk are administered by the College of Sciences and Humanities.

BUILDING CONSTRUCTION

Professor in Charge: Thomas C. Jellinger, M.S.

Opportunities for Undergraduate Study

The Department of Architecture 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.

Total credits required for graduation is 190, plus 6 credits in physical education.

For listing of curriculum by quarters, see Index.
COURSES PRIMARILY FOR UNDERGRADUATE STUDENTS

Courses in Architectural Engineering


313, 314, 315. DESIGN AND ANALYSIS OF ARCHITECTURAL STRUCTURES I. (0-9) Cr. 3 each Yr.
Prerequisite: 313: 213; 314: 313; 315: 314.
Projects in the design of Architectural structures and analysis of construction techniques. Properties of materials with emphasis on site engineering, codes, masonry systems and wood systems.

413, 414, 415. DESIGN AND ANALYSIS OF ARCHITECTURAL STRUCTURES II. (0-9) Cr. 3 each Yr.
Prerequisite: 413: 315 and credit or classification in C.E. 434; 414: 413; 415: 414.
Projects in the design of Architectural concrete, steel and special systems. Field trip.

425. SPECIAL PROBLEMS IN ARCHITECTURAL ENGINEERING. (0-9 to 27) Cr. 2 to 9. F.W.S.
Prerequisite: Senior or graduate classification, permission of department head.
Investigation of problems of special interest to the student.

513, 514, 515. DESIGN AND ANALYSIS OF ARCHITECTURAL STRUCTURES III. 513: (1-15) Cr. 6. F.; 514: (1-12) Cr. 5. W.; 515: (1-9) Cr. 4. S.
Prerequisite: 513: 415; C.E. 434: credit or classification in M.E. 407; 514: 513; 515: 514.
Projects in the design of Architectural engineering systems for buildings. Cost estimating, working drawings and specifications. Field trip.

CELL BIOLOGY

Advisory Committee: John H. D. Bryan, Ph.D. Chairman: Charles Clark Bowen, Ph.D.; William R. Lockhart, Ph.D.; L. Evans Roth, Ph.D.

Opportunities for 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.

Opportunities for Graduate Study

Major work in cell biology is offered for the degrees Master of Science and Doctor of Philosophy under a cooperative arrangement with the Departments of Bacteriology, Biochemistry and Biophysics, Botany and Plant Pathology, Genetics, and Zoology and Entomology; 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. This program will include a number of the following courses as appropriate. Agron. 623; Bact. 509, 531, 621, 631, 632, 633, 698; B. & B. 501, 502, 503, 561, 562, 574, 575, 578, 698; Bot. 500, 504, 511, 512, 513, 555, 556, 605, 624, 641, 642, 643, 644, 698E; Gen. 560, 630, 635, 640, 645, 646, 698; Stat. 535, 536; Zool. 511, 512, 528, 529, 532, 538, 550, 551, 552, 553, 554, 555, 627, 698.

CERAMIC ENGINEERING

David R. Wilder, Ph.D., Head of Department

Professors: Charles M. Dodd, Cer.E.; Thomas D. McGee, Ph.D.
Assistant Professors: Orville Hunter, Ph.D.; John T. Jones, Ph.D.; Elmer A. Rosauer, Dr. Rer. Nat.
Instructors: Michael F. Berard, M.S.; W. Raymond McMahon, M.S.
Opportunities for 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.

Opportunities for Graduate Study

The department offers major work leading to the degree Master of Science and Doctor of Philosophy in ceramics and 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.

Open to graduate students for minor only: 415, 416, 417.

COURSES PRIMARILY FOR UNDERGRADUATE STUDENTS

100. ORIENTATION. (1-0) Cr. R. S.
201, 202, 203. SEMINAR. (1-0) Cr. R. Yr.
213. CERAMIC RAW MATERIALS. (4-0) Cr. 4. F.
   Prerequisite: Chem. 103. Geological formation; occurrence; behavior; chemical and physical properties of the more important ceramic raw materials.
214. CERAMIC ENGINEERING OPERATIONS I. (3-3) Cr. 4. W.
   Engineering theory and problem solution in materials handling, preparation and forming operations.
215. CERAMIC CALCULATIONS AND PYROMETRY. (3-6) Cr. 5. S.
301, 302, 303. SEMINAR. (1-0) Cr. R. Yr.
311. CERAMIC COLLOIDS AND PHASE EQUILIBRIA. (4-0) Cr. 4. F.
   Prerequisite: 213. Fundamental phenomena found in ceramic and related colloids. Phase equilibria in ceramic compositions.
312. VITREOUS STATE. (3-3) Cr. 4. W.
   Theory of vitreous state in ceramic glasses and bodies. Glass formation and colors in vitreous state.
323. CERAMIC ENGINEERING OPERATIONS II. (4-0) Cr. 4. S.
   Prerequisite: 214. Drying, firing, diffusion processes occurring in ceramic industries. Fuels and combustion in ceramic kilns and driers.
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 students of Architecture.
400. INSPECTION TRIP. Cr. R. S.
   Prerequisite: Junior ceramic engineering classification. One week trip inspecting ceramic plants and studying industrial methods of production.
401, 402, 403. SEMINAR. (1-0) Cr. R. Yr.
415. CERAMIC INDUSTRIES I. (3-0) Cr. 3. F.
   Prerequisite: 312. Compositions, applications and nature of various ceramic bodies and glazes. General structure of the whiteware industries.
416. CERAMIC INDUSTRIES II. (3-0) Cr. 3. W.
   Prerequisite: 215 or permission of instructor. Manufacture, properties, uses, performance and testing of basic, neutral and acid refractories.
417. CERAMIC INDUSTRIES III.  
(3-0) Cr. 3. S.  
Prerequisite: 312.  
Plant layout, design, economic aspects and industrial structure of the vitreous industries, enamel and glass. Inspection trip to porcelain enamel plant.

427. CERAMIC ENGINEERING DESIGN  
(2-9) Cr. 5. W.  
Prerequisite: E.M. 324.  
Introduction to design of steel and concrete structural components of ceramic equipment and ceramic plant structures.

428. CERAMIC ENGINEERING DESIGN.  
(1-9) Cr. 4. S.  
Prerequisite: 427.  
Engineering design of kilns, dryers and associated equipment.

430. CERAMIC DEVELOPMENT AND CONTROL.  
(0-12) Cr. 4. F.  
Prerequisite: 323.

COURSES PRIMARILY FOR GRADUATE STUDENTS, major or minor, open to qualified undergraduates

511. CERAMIC TECHNOLOGY.  
(3-0) Cr. 3.  
Prerequisite: Permission of Instructor.  
Chemistry and technology of high temperature refractories, for the student not majoring in ceramic engineering.

512. CERAMIC TECHNOLOGY.  
(3-0) Cr. 3.  
Prerequisite: Permission of Instructor.  
Chemistry and technology of glassy ceramics—glasses, enamels and glazes.

513. CERAMIC TECHNOLOGY.  
(3-0) Cr. 3. S.  
Prerequisite: 441 or permission of instructor.  
Theory and technology involved in the manufacture of ceramic solid state devices for electrical and electronic utilization. Correlation of electronic and crystal structure with the electrical properties of such devices.

514. ELECTRON MICROSCOPY OF INORGANIC MATERIALS.  
(3-3) Cr. 4.  
Prerequisite: Math. 321, Phys. 223 or permission of instructor.  

515. SPECIAL TOPICS IN ELECTRON MICROSCOPY.  
Cr. 3 to 5.  
Prerequisite: 514 or permission of instructor.  
Special topics with emphasis given to an electron microscopic analysis of ceramic and other raw material systems. Advanced techniques in electron microscopy.

532, 533. THEORY AND PROPERTIES OF COLLOIDAL AND RELATED CERAMIC MATERIALS.  
(3-0) Cr. 3.  
Prerequisite: Permission of instructor.  
Fundamentals of colloidal phenomena as applied to ceramic systems, including theory of defloculation, rheology and measurements.

535. 536. CERAMIC COLLOIDS LABORATORY.  
(0-6) Cr. 2 each.  
Prerequisite: Concurrent with 532, 533.

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. F.  
Fundamentals of the elastic, anelastic, and plastic properties of ionic and covalent solids. Viscoelastic behavior of vitreous and vitreous-solid systems. Point defect, disorder, grain boundary, and polyphase contributions to mechanical properties.

612. KINETICS OF CERAMIC PROCESSES.  
(3-0) Cr. 3. W.  
Fundamentals of solid reactions occurring at elevated temperatures. Sintering, vitrification, diffusional mechanisms and effects, reaction rate theory.

613. MEASUREMENTS IN HIGH TEMPERATURE SYSTEMS.  
(3-0) Cr. 3. S.  
Theory, limitation, and problems of analysis of measurements at elevated temperatures. Furnaces and techniques for determination of mechanical, physical, structural, and chemical properties of ceramic materials at elevated temperatures.

618. CRYSTAL CHEMISTRY OF CERAMIC MATERIALS.  
(3-0) Cr. 3.  
Prerequisite: Permission of Instructor.  
Fundamentals of crystal chemistry and the systematic study of the structures of the ceramic materials.
619. **PHASE EQUILIBRIA OF CERAMIC SYSTEMS.**  
(3-0) Cr. 3. S.  
Prerequisite: 618 or permission of instructor.  
Phase equilibria of the ceramic and closely related systems

621, 622, 623. **ADVANCED CERAMIC ENGINEERING DESIGN.**  
(2-6) Cr. 4 each.  
Prerequisite: 428.  
Specialized ceramic machinery, driers, kilns and plant structures.

690. **RESEARCH.**

### CHEMICAL ENGINEERING

George Burnet, Jr., Ph.D., Head of Department

*Professors:* Lionel K. Arnold, Ph.D.; David R. Boylan, Jr., Ph.D.; Lawrence E. Burkhart, Ph.D.; Maurice A. Larson, Ph.D.; Morton Smutz, Ph.D.; Thomas D. Wheelock, Ph.D.

*Associate Professors:* William H. Abraham, Ph.D.; Richard C. Seagrave, Ph.D.; John B. Sheeler, Ph.D.; F. Dee Stevenson, Ph.D.; George T. Tsao, Ph.D.

*Assistant Professors:* Edgar V. Collins, Jr., M.S.; Albert C. Miller, B.S.; Allen H. Pulsifer, Ph.D.; Robert W. Shearer, B.S.; Frank O. Shuck, Ph.D.; John D. Stevens, Ph.D.

*Instructors:* Allen B. Beach, B.S.; Risdon W. Hankinson, M.S.

### Opportunities for 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 aircraft industries as well as in private and governmental research and educational institutions. He is helping to solve important problems arising in rocketry and space exploration. His field has developed so rapidly and has become so broad that it has become necessary to offer specialized training in the two areas described below.

A five-year cooperative work-study program is available in the Chemical Engineering Department. See *College of Engineering, Cooperative Programs.*

### Design and Production Option

The Design and Production Option is for students who are interested in the design, construction, operation and management of manufacturing plants in which raw materials are processed to produce chemical, petroleum, plastic, fertilizer, pesticide, soap, paint, drug, food, paper and other products. This option provides a broad training in chemistry and engineering and emphasizes the application of basic principles to the solution of industrial problems.

### Research and Development Option

The Research and Development Option is for students who are interested in basic or applied research and development or graduate training. It stresses mathematics, science and engineering fundamentals and it places great importance on developing the power to solve the new and untried problems of tomorrow.

### Opportunities for 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.


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.

203. INTRODUCTION TO UNIT OPERATIONS. (3-0) Cr. 3. S.
Prerequisite: 202.
Operations such as fluid flow, crushing, grinding, and mixing.

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: 361, 362. Math. 213.
Applications of digital and analog computers to the solution of problems arising in transport processes, chemical reactions, process dynamics, and equipment design

361. 362, 363. CHEMICAL ENGINEERING UNIT OPERATIONS. (3-0) Cr. 3 each. Yr.
Prerequisite: 203.
Operations common to many industrial processes such as size separation and filtration, heat transfer, mass transfer, gas absorption, distillation and extraction.

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.

421, 422. CHEMICAL ENGINEERING LABORATORY. (0-6) Cr. 2 each. W-S.
Prerequisite: Credit or classification in 361, 362, 363.
Laboratory application of the theory studied in 361, 362, and 363 to the testing and use of unit operation and process equipment; computation of experimental data; application of results to process design; writing of reports.

431, 432, 433. TRANSPORT PHENOMENA. (3-0) Cr. 3 each. Yr.
Prerequisite: Phys. 222, Math. 213.
The transport of momentum, energy and mass; determination of transport properties; the partial differential equations of change; turbulent gradients; correlation of transfer coefficients; macroscopic balances.

435. PROCESS CONTROL. (4-0) Cr. 4. F.
Prerequisite: 363, Math. 213.
Mechanisms used to control industrial processes, their applications and limitations. Dynamics of chemical process components and feedback control systems. Analog simulation of process systems.

450, 451. RATE PROCESSES LABORATORY. (0-4) Cr. 2 each. F-S.
Prerequisites: 450: Credit or classification in 435; 451: Credit or classification in 433.

461, 462. CHEMICAL ENGINEERING THERMODYNAMICS. (3-0 and 2-0) Cr. 3, 2. F-W.
Prerequisites: Math. 112, Phys. 222.
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 homogenous 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; investiga-

tion of an approved topic.
H. Honors Students.

471, 472, 473. CHEMICAL ENGINEERING DESIGN.
(1-6) Cr. 3 each. Yr.
Prerequisite: 361, 362, 363.
Principles of process development and plant design.

COURSES PRIMARILY FOR GRADUATE STUDENTS, major or minor, open to qualified undergraduates

501. PLASTICS TECHNOLOGY.
(3-0) Cr. 3. S.
Prerequisite: Chem. 335.
Chemistry and technology of plastic resins, production and use of finished plastic products.

511 NUCLEAR FUELS AND WASTES.
(Nuc. E. 511) See Nuclear Engineering.

512. REPROCESSING NUCLEAR FUELS.
(Nuc. E. 512) See Nuclear Engineering.

514. MATERIALS OF CONSTRUCTION FOR THE CHEMICAL INDUSTRIES.
(3-0) Cr. 3. W.
Prerequisite: Permission of instructor.
Properties of materials in the presence of corrosive media, selection of materials of construction for chemical processes.

515. ORGANIC CHEMICAL INDUSTRIES.
(3-0) Cr. 3. S.S.
Prerequisite: 411.
Chemical engineering aspects of manufacture of the principal organic chemicals.

516 HEAVY INORGANIC CHEMICAL AND FERTILIZER INDUSTRIES.
(3-0) Cr. 3. SS.
Prerequisite: 411.
Manufacture of commercial fertilizers and related heavy inorganic chemicals.

517. UTILIZATION OF AGRICULTURAL PRODUCTS AND BY-PRODUCTS.
(3-0) Cr. 3. W.
Prerequisite: Chem. 336.
Occurrence and chemical composition of agricultural products and by-products and their present and possible future utilization in manufactured products.

518. OIL AND FAT INDUSTRIES.
(3-0) Cr. 3. F.
Prerequisite: Chem. 335.
Occurrence and composition of vegetable and animal oil, and fat-bearing materials, methods of oil separation, refining, and bleaching, utilization in products such as foods, paints, and soaps.

535. PROCESS DYNAMICS.
(3-0) Cr. 3. W.
Prerequisite: 435.
Applications of dynamic analysis techniques in the study of non-steady state chemical processes.

541. 542, 543. ADVANCED CALCULATION METHODS FOR CHEMICAL ENGINEERS.
(3-0) Cr. 3 each. Yr.
Prerequisite: 541: 363 or 433, credit or classification in Math. 322; 542: 541, credit or classification in Math. 410; 543: 542.
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 543 Advanced analysis and design of equipment and processes requiring specialized mathematical techniques.

554, 555, 556. ADVANCED UNIT OPERATIONS.
(3-0) Cr. 3 each. Yr.
Prerequisite: 363.
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.
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: 363.
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: 363.
Theory and application of solvent extraction to industrial processing.

574 ADVANCED PEANUT DESIGN.
(1-6) Cr. 3. F.
Prerequisite: 473.
Special problems in plant design.

581. THERMODYNAMICS OF SINGLE COMPONENT SYSTEMS.
(3-0) Cr. 3. W.
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. S.
Prerequisite: 581.
Thermodynamic properties of solutions. Phase equilibria and chemical reaction equilibria.

584. APPLIED ELECTRO-CHEMISTRY.
(3-0) Cr. 3. S.
Prerequisite: 411.
Primary cells and storage batteries; electrolytic processes of chemical manufacture; electro-refining and electro-winning; electric furnaces and electric furnace products.
CHEMICAL ENGINEERING

KINETICS.

(3-0) Cr. 3 SS.
PREREQUISITE: 463.
Theory of absolute reaction rates, heat and transfer in catalytic beds, treatment of differential and integral conversion data.

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, chemical engineering of nuclear processes, liquid-liquid extraction, cost estimation and special topics in thermodynamics.

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: 433, 556, Mat 322, 410.

CHEMISTRY

Robert S. Hansen, Ph.D., Chairman of Department


Associate Professors: Rachel H. Edgar, Ph.D.; Donald R. Fitzwater, Ph.D.; Robert A. Jacobson, Ph.D.; Robert E. McCarley, Ph.D.; John G. Verkade, Ph.D.


Instructors: Thomas A. Beineke, Ph.D.; Charles A. Kingsbury, Ph.D.; Gerald A. Pearson, Ph.D.; Charles J. V. Scanio, Ph.D.
Opportunities for 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 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 Bachelor of Science degree. 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: 100, 102A, 103 (or 107, 108), 203, 214, 215, 224, 237, 316, 325, 326, 327, 330, 331, 332, 333, 401, 402 and 6 credits advanced chemistry. As supporting work undergraduate majors have found the following courses desirable: Math. 110, 111, 112, 213; Physics 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.

Opportunities for 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: 320, 321, 322, 323, 334, 335, 336, 401, 408, 426, 466, 483, 484.

Index to field of work is given by the second and third figures of course numbers

(a) Systematic Inorganic Chemistry
(b) Analytical Chemistry
(c) Physical Chemistry
(d) Organic Chemistry
(e) Open
(f) Household (including Textile) Chemistry
(g) Open
(h) Physical Chemistry
(i) Research

For courses in biochemistry, biophysics and metallurgy, see Index.

COURSES PRIMARILY FOR UNDERGRADUATE STUDENTS

100. ORIENTATION. (1-0) Cr. 1. F.W. An introduction to the various fields of chemistry to assist chemistry majors in electing areas of concentration.
101, 102. GENERAL CHEMISTRY.
(3-4) Cr. 4 each. 101: F.W.S.S.; 102: W.S.S.S.
Principles of chemistry; properties of non-metallic and metallic elements. 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. F.
Principles of chemistry; properties of metallic and non-metallic elements. Students with one unit of high school chemistry will be classified in either 101A or 102A during the fall quarter; classification in 102A will be 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 enrolled in 102A may receive credit in both 101A and 102A. 103 is offered winter quarter and 203, 211, and 214 are offered spring quarter so that students may take full advantage of the accelerated program. 101A is not acceptable for credit toward graduation for students majoring in chemistry.

103. SYSTEMATIC INORGANIC CHEMISTRY.
(3-4) Cr. 4. W.S.S.S.
Prerequisite: 102, or grade of A or B in 106.
Extension of General Chemistry, introduction to the reactions of individual elements and to group reactions as used in the determination of the composition of matter.

105. 106. GENERAL CHEMISTRY.
(3-4) Cr. 4 each. F.W; 106: W.S.
Prerequisite: Assignment by classifying dean in cooperation with Chemistry Department, with view to competence in mathematics and English.
For Home Economics students. Principles of chemistry; properties of non-metallic and metallic elements.

107, 108. PRINCIPLES OF MODERN CHEMISTRY.
(3-4) Cr. 4 each. F.W.
Prerequisite: High school chemistry and physics, and concurrent registration in Math. 110.
Principles of chemistry explored at greater depth than in Chem. 102A. 103 may be elected by well-prepared students in Sciences and Humanities who meet the prerequisites and desire a more rigorous course.

203. INORGANIC CHEMISTRY.
(3-0) Cr. 3. F.S.
Prerequisite: 102.
Descriptive and systematic chemistry of the elements with emphasis upon the periodic table. Elementary physical-chemical principles with regard to inorganic reactions and structure will be discussed.

205, 206. GENERAL CHEMISTRY.
(3-4) Cr. 4 each. F.W.
Prerequisite: 1 unit of high school chemistry, Phys. 223, Math. 112.
Principles of chemistry; properties of metallic and non-metallic elements. For students in engineering.

211. QUANTITATIVE ANALYSIS.
(3-6) Cr. 5. F.W.S.S.
Prerequisite: 103.
A one-quarter course in theory and practice of elementary gravimetric, volumetric, and colorimetric analysis. Ceramic engineers only may receive 4 credits (3-3).

212. QUANTITATIVE ANALYSIS.
(1-9) Cr. 4. S.
Prerequisite: 211.
Clay analysis. For students in ceramic engineering.

214. QUANTITATIVE ANALYSIS.
(3-6) Cr. 5. F.S.
Prerequisite: 103.
Theory and practice of elementary gravimetric, volumetric and colorimetric analysis. Only for students majoring in chemistry or biochemistry.

215. QUANTITATIVE ANALYSIS.
(3-6) Cr. 5. W.
Prerequisite: 214.
Theory and practice of quantitative separations, titration curves, and electroanalytical methods. Only for students majoring in chemistry or biochemistry.

224. PHYSICAL CHEMISTRY.
(3-0) Cr. 3. S.
Prerequisite: 214, Math. 112, Phys. 112 or 222.
Elementary thermodynamics and theory of the gaseous state. Homogeneous equilibria. Only for students majoring in chemistry or biochemistry.

231. ELEMENTARY ORGANIC CHEMISTRY.
(3-3 or 6) Cr. 4 or 5. F.W.S.S.S.
Prerequisite: 102 or 106.
Fundamentals of organic chemistry for students in Home Economics and Agriculture. Agriculture students will automatically elect this course for 5 credits, Home Economics students automatically will elect for 4 credits.

237. PRINCIPLES OF ORGANIC CHEMISTRY.
(3-0) Cr. 3. S.
Prerequisite: 108 or 214.
Nomenclature and functional groups. The geometry of organic compounds. Covalent bonds, hybridization and delocalization. The proof of structure of organic compounds. Spectroscopy. Factors that control the reactivity of organic compounds.

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 inches in qualitative analysis. Designed especially for students who wish to prepare for graduate courses in inorganic chemistry.

316. QUANTITATIVE ANALYSIS.
(3-6) Cr. 5. S.
Prerequisite: 215, 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.
Description of Courses

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320A. 320B. 320C. LABORATORY IN PHYSICAL CHEMISTRY.
320A. 320C: (0-3) Cr. 1 each. F. S.
320B: (1-3) Cr. 2. W.
To accompany 321, 322, 323.

321, 322, 323. PHYSICAL CHEMISTRY.
(3-0) Cr. 3 each. Yr.
Prerequisites: 211 or 214, Phys. 223, Math. 112 preferred.
Properties of gases, liquids and solids, solutions, 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 or biochemistry.

326. PHYSICAL CHEMISTRY.
(3-0) Cr. 3. W.
Prerequisite: 325.
Liquids and crystal. Molecular structure Quantum theory and spectra Kinetics, surface chemistry. Nuclear chemistry. For students majoring in chemistry or biochemistry.

327A. 327B. EXPERIMENTAL PHYSICAL CHEMISTRY.
(0-6) Cr. 3 each. 327A: F. 327B: W.
Prerequisite: 215.
To accompany 325 and 326. Only for students majoring in chemistry 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: 215.
To accompany 331, 332, 333. Only for students majoring in chemistry or biochemistry.

331, 332, 333. ORGANIC CHEMISTRY.
331, 333: (3-0) Cr. 3 each; 332: (2-0) Cr. 2. Yr.
Prerequisite: 214.
331, 332 Chemistry of aliphatic and aromatic compounds. Heterocyclic chemistry. Only for students majoring in chemistry or biochemistry. 333: Modern research techniques and their use in organic chemistry. Only for students majoring in chemistry or biochemistry.

334. ORGANIC CHEMISTRY.
(4-0) Cr. 4. F.W.
Prerequisite: 103.
During the sequence 334, 335, 336 the chemistry of carbohydrates, lipids, proteins, purines and pyrimidines will be covered. Premedical students must elect 334, 335, 336 with laboratory the last two quarters For students majoring in biological or applied sciences. Students majoring in chemistry ordinarily will elect 331, 332, 333.

335. ORGANIC CHEMISTRY.
(2-0 or 6) Cr. 2 or 4. W.S.
Prerequisite: 334.
A continuation of 334 and an introduction to laboratory work in organic chemistry. The sequence 334, 335 will satisfy the requirements for admission to the curriculum in Veterinary Medicine. A course in quantitative analysis is advised.

336. ORGANIC CHEMISTRY.
(3-0 or 3) Cr. 3 or 4. S.
A course for students needing additional organic chemistry beyond 335 Principally polyfunctional and heterocyclic chemistry.

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, refrigerants, lubricants 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.
A. Undergraduate Research Cr. var.
F.W.S.S.S.
Prerequisite: Permission of staff member with whom the student proposes to work.
B. Introduction to Chemical Research
(2-0) Cr. 2. F.
Prerequisite: Junior standing in chemistry and permission of instructor.
Introduction to research methods in chemistry.
C. Modern Chemistry
Cr. Arr. F.W.S.S.S.

401. ADVANCED INORGANIC CHEMISTRY.
(3-0) Cr. 3. F.
Prerequisite: 326.
The nature of bonding in inorganic systems; the application of thermodynamics, kinetics and structure to the study of inorganic systems. For students majoring in chemistry and biochemistry.

402. ADVANCED INORGANIC LABORATORY.
(0-6) Cr. 2. F.
To accompany 401. Only for students majoring in chemistry or biochemistry.

408. RADIOCHEMISTRY.
(2-6) Cr. 4. F.
For students in engineering. Fundamental principles of radioactivity; theory, operation and uses of radiation measuring instruments, principles of radiochemistry.

426. RADIOTRACER METHODS.
(2-0) Cr. 2. F.
Prerequisite: 323 or 326 or 483; Phys. 112.
For students in biology and Agriculture. Fundamental principles of radioisotope techniques and their applications to problems in biology and allied sciences.

466. TEXTILE CHEMISTRY.
(2-0 or 6) Cr. 2 or 4. F.S.
Prerequisite: 231.
Reaction of fibers during modification and finishing.
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 of chemical engineering.

495. SENIOR THESIS RESEARCH.

COURSES PRIMARILY FOR GRADUATE STUDENTS, major or minor, open to qualified undergraduates

500. THE HISTORY OF CHEMISTRY.  
(2-0) Cr. 2. S.  
Prerequisite: 322 or 325, 332 or 335. Diehl. The historical development of chemistry.

501. INORGANIC PREPARATION.  
(0-6 or more) Cr. 2 or more each time elected.  
Prerequisite: 401.  
Preparation of inorganic compounds providing experience in two or three general areas such as high vacuum techniques, non-aqueous solvents, high temperature reactions, coordination compounds, electrochemistry.

505. PHYSICAL PRINCIPLES OF INORGANIC CHEMISTRY.  
(3-0) Cr. 3. F.S.  
Prerequisite: 203 and 323 or 326. Corbett, Martin.  
Theoretical approach for the systematization of inorganic chemistry.

514. ELECTROCHEMICAL METHODS OF ANALYSIS.  
(2-3) Cr. 3. F.  
Prerequisite: 316, 323 or 326, 333 or 336. Banks, Diehl, Fassel, Fritz, Goetz, Marple.  
Basic principles and applications of electrochemical methods and mass spectrometry.

515. ANALYTICAL ATOMIC SPECTROSCOPY LABORATORY.  
(0-6) Cr. 2. F.W.S.  
Prerequisite: 514. Fassel.

Laboratory in optical emission, atomic absorption, and X-ray fluorescence spectroscopy.

516. QUANTITATIVE ORGANIC ANALYSIS.  
(1-3 to 9) Cr. 2 or 3 each time taken.  
Prerequisite: 333 or 336. Fritz.  
Chemical analysis via functional groups, kinetic methods, spectrophotometric and physical methods, analytical separations.  
Optional laboratory work on a special analytical problem.

517. SPECIAL PROBLEMS IN ANALYTICAL CHEMISTRY.  
(0-12) Cr. 1 to 4. F.W.S.S.  
Prerequisite: Permission of instructor.  
Banks, Diehl, Fritz, Goetz, Marple.  
Laboratory work on a special project in chemical analysis.

519. QUANTITATIVE MICROCHEMICAL ANALYSIS.  
(1-6) Cr. 3. Alt. S. Offered 1968.  
Prerequisite: 316, 323 or 326, or 336. Fritz.  
Microtechniques of organic analysis.

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 1969.  
Prerequisite: 323 or 326. Hansen.  
Basic principles and applications.

526. 527. RADIOCHEMISTRY.  
(2-0) Cr. 2 each. Alt. W. Offered 1968.  
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 RADIONTRACER TECHNIQUES.  
(6-0) Cr. 2. W.S.  
Prerequisite: 426. Voigt.  
Training in measuring radioactive substances and in their handling through chemical and biological experiments.
290 Description of Courses

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.
Prerequisite: 333 or 336; permission of staff member with whom work is to be done. Preliminary research work in synthesis and study of reactions of compounds of theoretical and industrial importance.

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.S.S.
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 326; 582: 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: 401 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, aqueous solutions, 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, Marple.

620. SEMINAR IN PHYSICAL CHEMISTRY. (1-0) Cr. 1 each time elected. F.W.S.S.S.
Prerequisite: Permission of Instructor. Physical chemistry staff.

621. STATISTICAL THERMODYNAMICS. (3-0) Cr. 3 each time taken. Alt. F.W.S. Offered 1967-1968.
Prerequisite: Permission of instructor. Hansen.
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 1968-1969.
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: 521 or 581.
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. XRAY 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 method; examples of structures deduced from X-ray investigations.

631. SEMINAR IN ORGANIC CHEMISTRY. (1-0) Cr. 1 each time elected. F.W.S.S.S.
Prerequisite: Permission of Instructor. Organic staff.

633. SPECIAL TOPICS IN ORGANO-METALLIC CHEMISTRY. (2-0) Cr. 2. Alt. S. Offered 1969.
Prerequisite: Reading knowledge of German. Gilman.

636, 637. PHYSICAL ORGANIC CHEMISTRY. (2-0) Cr. 2 each. W.S.
Prerequisite: 531, 532, permission of instructor. Russell.
Selected topics in the fields of reaction mechanisms, kinetics and structural theory as applied to organic molecules.

638, 639. CHEMISTRY OF ORGANIC NATURAL PRODUCTS. (2-0) Cr. 2 each F.S.
Prerequisite: 531, 532, permission of instructor. Chapman, Wildman.
Discussion of selected topics in the chemistry of naturally occurring substances; degradation and synthesis of alkaloids, terpenes, steroids, antibiotics; photochemistry; and the chemistry of heterocyclic and troponoid substances.

Opportunities for Undergraduate Study

For undergraduate curricula in child development leading to the degree Bachelor of Science, see Home Economics, Curricula.

The curricula in child development provide specialized training for professional work with children and families in connection with nursery schools, elementary schools, hospital recreation programs, settlement houses, welfare agencies, programs for handicapped children or emotionally disturbed children and in recreational programs for older children, such as Girl Scouts, Campfire Girls or youth programs of the Extension Service. Opportunities to observe and work with infants, preschool and school age children are offered.

Three areas of preparation are offered: child development, child development-elementary education, child development and related science.

Students may enroll in the child development-elementary education curriculum as sophomores but must apply to and be accepted by the departmental committee on selection and the University Committee on Teacher Education in order to advance to the teacher education program.

Further information for students wishing to combine preparation for work in radio or television with this curriculum is found under Home Economics, Radio and Television, and under Telecommunicative Arts.

Opportunities for Graduate Study

The department offers major work for the degrees Master of Science and Doctor of Philosophy in child development and minor work to students taking major work in other departments.

It is recommended that the student have a general background in home economics, child development or other behavioral sciences.

The foreign language requirements for the degree Master of Science may be waived upon recommendation of the department head. For the language requirement for the degree Doctor of Philosophy, see the Graduate College.

Open to graduate students for minor only: 434, 444, 460, 461.

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.

270. THE INDIVIDUAL AND HIS FAMILY I.
(4-0) Cr. 4. F.W.S. SSII.SSII.
Prerequisite: Psych. 101, Soc. 134, 218. Interrelations of the individual and his family through the stages of the family's life cycle.
336. DEVELOPMENT IN EARLY CHILDHOOD.
(3-0) Cr. 3. F.W.S.
Prerequisite: 236.
Social, emotional, motor and intellectual development of children to five years.

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 in a variety of settings.

366. ACTIVITIES AND MATERIALS.
(3-0 or 3-2) Cr. 3 or 4. F.W.S.SSI.
Prerequisite: 336, 337.
Principles underlying the selection and use of materials and activities for children to 12 years of age. Advance laboratory reservation required.

368. STUDY TOUR.
Cr. R. S.
Prerequisite: Junior classification.
Visit and study varied types of child and family centers, institutions and agencies.

375. THE TEACHING OF READING
(ED. 375).
(5-0) Cr. 5. F.W.S. SSI.
Prerequisite: Ed. 204, Psych. 333, C.D. 366.

434. DEVELOPMENT IN INFANCY.
(3-0) Cr. 3. W.S. SSI.
Prerequisite: 9 credits in C.D. and Psych.
Developmental characteristics during the first two years with implications for guidance and care.

444. PRINCIPLES OF TEACHING IN THE ELEMENTARY SCHOOL.
(2-0) Cr. 2. F.W.S.SSI
Prerequisite: 366, Ed. 204, Psych. 333, admission into teacher preparation program.
Basic dimensions of teaching method for elementary grades Field trips to selected elementary schools.

445. ELEMENTARY EDUCATION METHODS I.
(4-0) Cr. 4. F.W.S.SSI.
Prerequisite: 444.
Essential procedures in teaching language arts and social studies in the elementary grades.

446. ELEMENTARY EDUCATION METHODS II.
(4-0) Cr. 4. W.S. SSI.
Prerequisite: 444; Math. 190.
Essential procedures in teaching mathematics and science in the elementary grades.

460. GUIDANCE OF CHILDREN.
(3-2) Cr. 4. F.W.S.SSI.
Prerequisite: 366.
Principles of guidance applied to children in group situations. Observation of adult-child interaction.

461. CURRICULUM PLANNING FOR THE PRESCHOOL CHILD.
(2-0) Cr. 2. F.W.S.SSI.
Prerequisite: 460.
Principles and techniques of planning a curriculum for a group of preschool age children.

465. SEMINAR.
(2-0) Cr. 2. F.
Prerequisite: 366, senior classification and quality point average 2.5.
Preparation and presentation of reports on original investigations in child development.

467A. SUPERVISED TEACHING IN NURSERY SCHOOL.
(0-18) Cr. 6. F.W.S.SSI.
Prerequisite: 461, classification in 467B.
Experience in teaching a group of nursery school children for a period of six weeks. Advance reservation required.

467B. HOME-SCHOOL RELATIONS.
(2-0) Cr. 2. F.W.S.SSI.
Prerequisite: Classification in 467A.
Planning and participating in home-school relations programs. Advance reservation required.

467C. STUDENT TEACHING IN THE PRIMARY GRADES.
(0-24) Cr. 8. F.W.S.
Prerequisite: 445, 446, 460 cumative point average 2.3.
Experience in teaching in the primary grades Advance reservation required.

467D. STUDENT TEACHING IN THE INTERMEDIATE GRADES.
(0-24) Cr. 8. F.W.S.
Prerequisite: 445, 446, 460 cumative point average 2.3.
Experience in teaching in the intermediate grades Advance reservation required.

468. ADMINISTRATION OF PROGRAMS FOR YOUNG CHILDREN.
(2-3) Cr. 3. 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.

481. GROUP WORK WITH CHILDREN I.
(0-6) Cr. 2. F.W.S.SSI.
Prerequisite: 460.
Observation in group activities of children of various ages. Advance reservation required. Concurrent classification in 482 required.

483. GROUP WORK WITH CHILDREN II.
(0-18) Cr. 6. F.W.S.
Participation in group activities of children of various ages. Advance reservation required. Concurrent classification in 481 required.

490. SPECIAL PROBLEMS.
Cr. Arr. F.W.S.SSI, II.
Prerequisite: 12 credits in C.D., permission of department head.
A. Child Development.
B. Family Relationships.
C. Nursery Education.
D. Elementary Education.
COURSES PRIMARILY FOR GRADUATE STUDENTS, major or minor, open to qualified undergraduates

519. RESEARCH METHODS IN CHILD DEVELOPMENT I.
(2-0) Cr. 2. W.
Prerequisite: Credit or classification in Stat. 401 or Educ. 552.
Research design and problems in methodology.

520. RESEARCH METHODS IN CHILD DEVELOPMENT II.
(2-0) Cr. 2. S.
Prerequisite: 519.
Advanced study of research design and methodology in child development. Emphasis on the laboratory-experimental study of the child.

537. THEORIES AND PRINCIPLES OF CHILD DEVELOPMENT.
(3-0) Cr. 3. F.
Prerequisite: 336, 337, 9 credits in Psych. Pease.
Analysis of the developmental approach to the study of child behavior. Emphasis upon principles of development.

540. IDENTIFICATION AND REMEDIACTION OF CLASSROOM LEARNING DISORDERS.
(3-0) Cr. 3. F. SSI.
Prerequisite: 436, 440.
A study of techniques, materials, and diagnostic procedures for the treatment of classroom learning difficulties. For teachers, child development specialists and others concerned with learning disabilities of children in the regular classroom.

541. EDUCATION OF THE GIFTED CHILD.
(3-0) Cr. 3. W. SSI.
Prerequisite: 336, 337.

542. THE DISADVANTAGED CHILD.
(2-0) Cr. 2. Alt. W.
Prerequisite: Psych. 333.
Identification and analysis of problems. Implications for the educative process.

545. THE COMMUNITY PROGRAM OF ELEMENTARY EDUCATION (Ed. 545)
(2 to 4-0) Cr. 2 to 4. SSI.
Prerequisite: Ed. 426.

570. THE INDIVIDUAL AND HIS FAMILY II.
(3-0) Cr. 3. S.
Prerequisite: 270 or equivalent. King.
Analysis of human behavior, as it relates to family development, from the biological, psychological and sociological fields.

572. PARENT EDUCATION.
(3-0) Cr. 3. F.
Prerequisite: 270, 336, 337.
Principles and procedures of instruction and evaluation in parent education.

575. CULTURAL FOUNDATIONS OF FAMILY LIFE.
(2 or 3-0) Cr. 2 or 3. F. SSI.
Prerequisite: 9 hours of behavioral sciences. Lee.
Cultural influences on the individual and family, on child-rearing practices and personality development; roles of family members; values, customs, taboos and rituals related to family life.

580. THEORIES AND PRACTICES IN THE EDUCATION OF THE YOUNG CHILD.
(3-0) 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.

581. SUPERVISED PROGRAMMING FOR CHILDREN.
Cr. Arr. F. W.
Prerequisite: 12 credits in C.D. and reservation.
Supervised programming for children in a variety of settings.

590. SPECIAL TOPICS.
F. W. SSI. II.
Prerequisite: 12 credits in C.D., permission of department head.
A. Child Development. Gardner, Pease.
C. Nursery Education
D. Elementary Education. Shea.

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. Gardner.
Analysis of methods in the clinical and experimental appraisal of children.

630. DEVELOPMENT OF BASIC PROCESSES IN CHILDREN: BODY FUNCTIONING.
(2-0) Cr. 2. Alt. W. Offered 1968.
Prerequisite: 537. Pease.
Theories and concepts of development, maturation and growth related to body functioning in children. Body functioning and personal social development.

631. DEVELOPMENT OF BASIC PROCESSES IN CHILDREN: COGNITION.
(2-0) Cr. 2. Alt. S. Offered 1967.
Prerequisite: 537.
Analysis of cognitive development in children.
Description of Courses

632. DEVELOPMENT OF BASIC PROCESSES IN CHILDREN: PERSONALITY.
(2-0) Cr. 2. Alt. S. Offered 1968.
Prerequisite: 537.
Analysis of personality formation in children.

633. DEVELOPMENT OF BASIC PROCESSES IN CHILDREN: SOCIAL DEVELOPMENT.
(2-0) Cr. 2. W. Offered 1967.
Prerequisite: 537.
Analysis of social development in children.

655. PLANNING COLLEGE COURSES IN CHILD DEVELOPMENT.
(3-0) Cr. 3. S.
Prerequisite: 600. Pease.
Selection, organization, presentation of subject matter

665. SEMINAR.
Cr. arr. F.W.S.
Gardner, King, Pease, Shea.

670. DYNAMICS OF PARENT-CHILD RELATIONSHIPS.
(2-0) Cr. 2. W.
Prerequisite: 15 credits in C.D. and Psych.
Theories of parent-child relations

690. RESEARCH.
F.W.S.SSI, II.
Gardner, King, Pease, Shea.

CIVIL ENGINEERING

Carl E. Ekberg, Jr., Ph.D., Head of Department


Assistant Professors: Merwin D. Dougal, M.S.; Hotten A. Elleby, Ph.D.; James M. Hoover, M.S.; Dah-yinn Lee, Ph.D.; Ti-Ta Lee, Ph.D.; Robert A. Lohnes, Ph.D.; Charles S. Oulman, Ph.D.


Opportunities for 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, including research, testing, sales, management and other functions that are related. The facilities commonly include transportation; bridges and buildings; water supply, sewage, irrigation, and drainage systems; river and harbor improvements; dams and reservoirs; surveys and maps.

Work on the campus is supplemented by inspection trips which furnish an opportunity for first-hand study of engineering work and industrial plants.

Opportunities for Graduate Study

The department offers work for the degree Master of Science and Master of Engineering in sanitary, structural, municipal, highway, soil and transportation engineering and major work for the degree Doctor of Philosophy in structural, sanitary, soil and transportation engineering 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 civil engineering at this institution, and including undergraduate courses necessary for the particular field chosen.
Students who major in civil engineering usually will select minor work from the Departments of Mathematics, Physics, Chemistry, Bacteriology, Geology, Economics, Statistics, or other engineering departments.


COURSES PRIMARILY FOR UNDERGRADUATE STUDENTS

100. TECHNICAL LECTURE.
(1-0) Cr. R.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. 102.
Surveying for resource development including principles of surveying measurements, topography, traversing, plane table mapping, field astronomy, and staking of buildings, curvatures and earthwork.

211, 211A, ELEMENTARY SURVEYING.
(0-9) Cr. 3. F.
Prerequisite: Math. 102.
Principles of surveying measurements, simple topography, site layout and traversing.
211A. Primarily for students in the College of Agriculture.

212. PHOTOGRAMMETRY, MAPPING AND LAND SURVEYING.
(2-9) Cr. 5. F.
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, surveying astronomy, and precise surveying measurements.

214. MAPPING, COMPUTATIONS AND LAND SURVEYING.
(2-9) Cr. 3. W.
Prerequisite: 210 or 211.
Mapping and computations related to stadia, simple horizontal and vertical curves, earthwork; elementary public land surveys and boundaries.

304. HYDROLOGY.
(2-3) Cr. 3. S.
Prerequisite: Credit or classification in E.M. 378.
Elements of hydrology, precipitation, water losses, stream flow and ground water hydraulics.

331. ANALYSIS OF STATICALLY DETERMINATE STRUCTURES.
(3-0) Cr. 3. F.W.
Prerequisite: E.M. 324.
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.

350. COLLABORATIVE TRANSPORTATION DEVELOPMENT.
(3-0) Cr. R.F.W.
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 industrial data for use in the location of transportation routes, parking, and terminal facilities.

352. PLANNING OF TRANSPORTATION FACILITIES.
(3-0) Cr. 3. W.S.
Prerequisite: 213, 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.S.
Prerequisite: Geol. 301. Credit or classification in E.M. 324.
Introduction to basic soil engineering; systems for identification and classification of soils; soil-water systems and interactive forces; principles of settlement and shearing stresses in soils; application of soil engineering in earth dams, retaining walls, foundations, piles and underground conduits.

361. SOIL AND AGGREGATE MATERIALS LABORATORY.
(3-0) Cr. 3. W.
Prerequisite: 360. 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. CEMENTS AND GRANULAR MIX DESIGN.
(3-0) Cr. 3. S.
Prerequisite: 361. E.M. 354.
Physical and chemical properties of bituminous, Portland, and other cements. Design of concrete and stabilized granular systems. Mixing, handling, placing and curing.

394. 395. PROFESSIONAL DEVELOPMENT.
Cr. R. F.W.
Oral reports and discussions of prominent engineers, notable engineering projects and related topics.

404. ENGINEERING IN CITY PLANNING.
(3-0) Cr. 3. W.
Prerequisites: Credit or classification in L.A. 426, 453, or 350; U.P. 361 or senior engineering classification.
Relation of sanitary works, transportation, and other utilities to city planning; housing, building codes, real estate subdivision, land titles.
415. ADVANCED METHODS OF PRECISE MEASUREMENT I.  
(2-3) Cr. 3. W.  
Prerequisite: 213.  
Theory and practice of optical tooling methods as applied to projects in research and industry. Use of mechanical and electrical strain gages for static and dynamic testing.

416. ADVANCED METHODS OF PRECISE MEASUREMENT II.  
(2-3) Cr. 3. S.  
Prerequisite: 213.  
Theory and practice in the precise measurement of long distances using tape and radar equipment. Elements of geodesy as applied to measurement of the earth’s shape and precise determination of geodetic positions.

417. LAND SURVEYING.  
(1-4 or 3-9) Cr. 3 or 6. F.  
Prerequisite: 213.  
A study of the methods used for the original government land surveys and subdivision and boundary retracement. Legal aspects of land surveying.

418. AERIAL PHOTOGRAMMETRY.  
(1-6) Cr. 3. W.  
Prerequisite: 212.  
Mapping by use of aerial photographs. Preparation of map and controlled mosaic from photographs of area near campus.

425 SANITARY ENGINEERING I.  
(2-3) Cr. 3. W.  
Prerequisite: Chem. 103, Math. 213, Phys. 221.  
Introduction to those studies in which engineering knowledge is applied to problems concerning public health, including water and waste water treatment, the prevention and control of air pollution, stream pollution and communicable diseases.

426. SANITARY ENGINEERING II.  
(2-6) Cr. 4. F.  
Prerequisite: 304, 425, E.M. 378.  
Engineering aspects of collection, pumping, storage and distribution of water for public, domestic and industrial uses, and collection of storm, sanitary, and combined waste water design of systems.

427. SANITARY ENGINEERING III.  
(2-3) Cr. 3. 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.  

433, 433A. STRUCTURAL DESIGN IN STEEL.  
433: (3-0) Cr. 3. F.S.; 433A: (3-2) Cr. 4. F.S.  
Design and behavior of the elements of steel structures, proportioning of members and connections, introduction to plastic design. 433A: Primarily for architectural students, with additional credit in architectural structural systems.

434. 434A. REINFORCED CONCRETE DESIGN.  
434: (3-0) Cr. 3. F.S.; 434A: (3-2) Cr. 4. F.W.  
Design and behavior of elements of reinforced concrete structures such as beams, columns, footings and slabs. 434A: Primarily for architectural students, with additional credit in architectural structural systems.

448. ANALYSIS AND DESIGN OF STRUCTURAL SYSTEMS.  
(3-0) Cr. 3. F.W.  
Prerequisite: 433, 434. Credit or classification in Math. 321.  
Analysis of structures by plastic theory and limit design concepts. Analysis of arches. Introduction 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, two-way slabs, flat slabs, steel joist floor systems, etc.

450. TRAFFIC ENGINEERING.  
(3-3) Cr. 4. F.  
Prerequisite: 352.  

451. TRAFFIC PLANNING.  
(3-2) Cr. 4. W.  
Prerequisite: 350 or 450.  
Planning of highway systems and terminals considered as a part of the complete planning approach. Traffic studies, projections, analysis, plan formulation, and programming.

453. DESIGNING TRANSPORTATION FACILITIES.  
(3-3) Cr. 4. F.  
Prerequisite: 304, 352, 362, E.M. 378.  
Location and safe geometric design of highway facilities. Earthwork and drainage related to highway, railway and airport design. Design, construction, and maintenance of pavements and stabilized bases.

460. FOUNDATIONS.  
(3-0) Cr. 3. S.  
Prerequisite: 360, 361.  
472. APPLIED HYDRAULIC DESIGN.  
(2-2) Cr. 3. S.  
Prerequisite: 304.  
Characteristics of flow in natural and artificial channels; hydraulic design of culverts, bridge waterway openings, spillways, stilling basins, hydraulic gates and gated structures, miscellaneous water control structures.

485. ENGINEERING CONSTRUCTION.  
(2-2) Cr. 3. F.S.  
Prerequisite: Credit or classification in E.M. 354.  
Quantity surveys, cost keeping, letting procedures and contract documents, form design, construction methods and equipment. Relations between contractor, owner, and engineer.

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; refuse collection and disposal; street and work maintenance; subdivision design and layout.

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 multi-purpose uses in water resources project planning.

526. INDUSTRIAL WASTE TREATMENT.  
(3-0) Cr. 3. Alt. F.  
Prerequisite: 522.  
Investigation of industrial waste treatment problems and methods of treatment. Study of unit operations required in industrial waste treatment methods.

527. 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. F.  
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, influence lines, 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.  

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 bridges, 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.

552. BITUMINOUS PAVING MATERIALS.  
(3-0) Cr. 3. F.  
Prerequisite: 362.  
Source, manufacture, processing, types, constituents, tests, chemical behavior, specifications, and uses of bituminous materials and aggregates in pavements.

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 zoning.

555. HIGHWAY ADMINISTRATION AND FINANCE.  
Cr. 3.  
Prerequisites: 552, 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.  
(3-0) Cr. 3. F.  
Prerequisite: 360, 361.  
Advanced treatment of theory and principles of engineering soil mechanics as related to permeability, capillarity, seepage forces, stress distribution, viscoelastic properties and pressure volume relationships of fine and coarse dispersed soil systems.

560B. SOIL MECHANICS II.  
(3-0) Cr. 3. W.  
Prerequisite: 560A.  
Applications of soil mechanics. Slope stability, earth pressures, bearing capacity, 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. Unconsolidated deposits, rock types, orientations and drainage patterns; weathering and soil profiles; landslides, fractures, and faults. Field checking of interpretations.

563. 564. ADVANCED SOIL ENGINEERING LABORATORY.  
(0 to 9) Cr. 2 to 3 each. F.W.  
Prerequisite: 563: Permission of Instructor; 564: Credit or classification in 560A.  
Advanced theory and techniques of soil engineering measurements. Analysis of soil and expansive clays by x-ray diffraction and differential thermal techniques. Triaxial shear, consolidation, permeability, capillarity testing and analyses; relation of hydrostatic excess pressures and compositional influences. Field bearing tests.
565. SOIL STABILITY.
(3-3) Cr. 4. 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. Testing of stabilized soils.

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 civil engineering.

586. MUNICIPAL 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.
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.
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. F.
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.

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.
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.
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. F.
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.

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.
Description of Courses

661. HIGHWAY SOIL ENGINEERING.
Cr. 3. W.
Prerequisite: 560B.
Stability, stress-strain characteristics and bearing capacity of subgrades; subsurface drainage, frost action and related phenomena. Principles of flexible and rigid pavement design.

663. EARTH DAMS.
(3-0) Cr. 3. Alt. S. Offered 1968.
Prerequisite: 560B
Location, selection of material, design and construction of earth dams.

664. 665. 666. STABILIZATION OF SOILS AND GRANULAR MATERIALS.
(3-0) Cr. 3. Alt. Yr. Offered 1968-1969.
Prerequisite: 565.
Granulometry and colloid chemistry as related to soil plasticity classification, strength and mix design. Use of chemical stabilizers, pozzolans and Portland cement.

690. RESEARCH.

699. SEMINAR.
Cr. R.

CLIMATOLOGY AND METEOROLOGY

Opportunities for Undergraduate Study

Two programs are available for undergraduate study, meteorology in earth science and agricultural climatology in agronomy. For the undergraduate curriculum in agronomy, major in agricultural climatology, see College of Agriculture, Curricula. For the undergraduate curriculum in sciences and humanities, major in geophysics, see Sciences and Humanities, Curriculum. Both programs lead to the degree Bachelor of Science. The following specific courses in climatology and meteorology are available to undergraduate students: Agron. 206 and 406, Geophys. 345, 346, 347 and 348. Related and supporting work is offered in the Departments of Physics, Agronomy, Statistics, Earth Science and Mathematics.

Opportunities for Graduate Study

Graduate study in the field of meteorology is administered by the Department of Earth Science, whereas, graduate study in agricultural climatology is administered by the Department of Agronomy.

The degree Master of Science is offered in both agricultural climatology and geophysics (meteorology). Graduate students working toward the degree Doctor of Philosophy in agronomy may specialize in agricultural climatology; those working towards the degree Doctor of Philosophy in earth science may specialize in geophysics (meteorology).

Prerequisite to graduate work in the field of agricultural climatology is the satisfactory completion of a suitable undergraduate program including the completion of five quarters of college mathematics, through differential and integral calculus, two quarters of college physics, elementary courses in statistics, meteorology and botany and the following courses in agronomy: 114, 154, 354 and 464.

Prerequisite to graduate work in meteorology is the satisfactory completion of a suitable undergraduate curriculum, including mathematics through differential and integral calculus; three quarters of college physics (calculus prerequisite); and three quarters of chemistry. Highly desirable are courses in statistics and differential equations and elementary courses in geology, meteorology, climatology and hydrology.

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.; Donald R. Fitzwater, Ph.D.; Howard W. Jespersen, M.S.; C. C. Mosier, B.S.; Robert A. Sharpe, M.S.
Assistant Professors: Thomas R. Rogge, Ph.D.; John D. Stevens, Ph.D.; Richard M. Willett, Ph.D.; Roy J. Zingg, M.S.
Instructors: George O. Strawn, B.A.; Lonnie B. Winrich, M.S.
Opportunities for Undergraduate Study

For undergraduate curriculum in sciences and humanities, major in computer science, leading to the degree Bachelor of Science, see Sciences and Humanities, Curricula.

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, 351, 352, 353, 406 and 410. The additional courses recommended for the four options are as follows: graduate study: 407, 408, 411, 412; Math. 404, 414, 415, 416; numerical analysis: 407, 408; Math. 321, 322, 323, 404, 414, 415, 416; statistics emphasis: 407, 408; Stat. 341, 342, 343, 401, 402; computer systems: 411, 412; E.E. 445, 446, 498 (information theory).

Phil. 370 is recommended as supporting work for each of the options. 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.

Opportunities for 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.

Additional work is usually required in mathematics, statistics, electrical engineering or certain other fields.

Courses open to graduate students for minor credit: 350, 351, 352, 353, 495, 499.

COURSES PRIMARILY FOR UNDERGRADUATE STUDENTS

214. INTRODUCTION TO COMPUTER ORGANIZATION AND PROGRAMMING. (3-0) Cr. 3. F.W.S.
Prerequisite: 10 Cr. in Math. and/or Stat.
Logical basis of a digital computer system; machine representation of numbers and characters; flow of control, arithmetic and logical operations; indexing; input-output; subroutines; linkage and recent advances in computer organization. Programming in problem oriented languages. Concepts illustrated and problems programmed on available computers.

221. COMPUTER ORGANIZATION AND PROGRAMMING I. (3-2) Cr. 4. F.
Prerequisite: 10 credits in Math. or Stat. Number systems; symbol and number representation; basic algorithmic processes; flow-charts, decision tables, switching matrices. Formulation and solution of a wide range of algorithmic processes on a small training computer and/or simulation on existing large scale digital computers.

222. COMPUTER ORGANIZATION AND PROGRAMMING II. (3-2) Cr. 4. W.
Prerequisite: 221.
Organization of a large scale digital computer, instructions and format; basic assembler language coding and formulation and solution of a variety of numerical and non-numerical problems in one or more high-level problem-oriented language.

223. COMPUTER PROGRAMMING. (3-0) Cr. 3. S.
Prerequisite: 222.
Fortran, Cobol, and I'L/I programming.

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, lists and list structures.
### Description of Courses

#### 351. ALGORITHMIC LANGUAGES AND COMPILERS.
(3-2) Cr. 4. F.
Prerequisite: 223.
Formal description of algorithmic languages and the techniques used in their compilation. Study of syntax semantics, ambiguities, procedures, replication, iteration and recursion in languages. Syntactic decomposition and the theory of computers which are syntax directed or recursively controlled.

#### 352. COMPUTER AND PROGRAMMING SYSTEMS I.
(3-2) Cr. 4. W.
Prerequisite: 351.
Design of assembly systems; program intercommunication, linking and symbolic reference between programs at loading time; input-output control systems; debugging systems; structure of program and data files; batch processing executive systems.

#### 353. COMPUTER AND PROGRAMMING SYSTEMS II.
(3-2) Cr. 4. S.
Prerequisite: 352.
Multi-programming and multi-processing systems; interrupt systems; storage protection, priorities and scheduling; dynamic allocation and reallocation of storage; on-line console time-sharing systems; programming system and language requirements in multi-programming and multi-processor systems.

### Courses Primarily for Graduate Students, Major or Minor, Open to Qualified Undergraduates

#### 501, 502, 503. PROGRAMMING LANGUAGES AND SYSTEMS.
(3-0) Cr. 3, each. F.W.S.
Prerequisite: 353.
Boolean algebra; logical structure in digital computing; machine languages; assembler and compiler systems; symbolic and problem-oriented language; monitor and executive systems; real-time; time-sharing multi-programming.

#### 507, 508. NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS.
(Math. 507-508) See Mathematics.

#### 509. COMPUTATIONAL METHODS OF LINEAR ALGEBRA.
(Math. 509) See Mathematics.

#### 580, 581. SCIENTIFIC APPLICATION OF DIGITAL COMPUTERS.

#### 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.

#### 680. SEMINAR ON ADVANCED COMPUTER TOPICS.

#### 684. ADVANCED SWITCHING THEORY.
(E.E. 684) See Electrical Engineering.

#### 685. ADVANCED LOGIC SYSTEMS.
(E.E. 685) See Electrical Engineering.

#### 686. AUTOMATA THEORY.
(E.E. 686) See Electrical Engineering.

#### 699. RESEARCH.
Graduate Staff.
For description of courses, see Agronomy

DAIRY AND FOOD INDUSTRY

Verner H. Nielsen, Ph.D., Head of Department


Associate Professors: Wilbur J. Caulfield, M.S.; Allen A. Kraft, Ph.D.; William W. Marion, Ph.D.; George W. Reinbold, Ph.D.; Winfield S. Rosenberger, B.S.; Harry E. Snyder, Ph.D.; Earl O. Wright, M.S.

Assistant Professors: Tai-Wan Kwon, Ph.D.; William S. LaGrange, Ph.D.; Dorris A. Lillard, Ph.D.; F. C. Parrish, Jr., Ph.D.; Rupert G. Seals, Ph.D.

Instructor: Robert V. Ogden, M.S.

Opportunities for Undergraduate Study

Food Technology

Food technology is the application of the sciences and engineering to the manufacture, storage, transportation, marketing and utilization of food products. It is based on the fundamentals of biology, chemistry, physics and microbiology and applied through engineering operations. The many aspects of food technology such as processing, preparation, packaging, research and development, quality control, marketing, utilization, foreign trade and government regulation create a variety of interesting career opportunities for food technologists. The curriculum combines breadth in science education with meaningful applications to food processing, preservation, sanitation, storage and distribution. It is constructed according to recommendations by professional societies. The elective credits permit flexibility in planning a course of study which will prepare for leadership positions in that phase of food technology where the student intends to build a career.

Dairy Technology

The option in dairy technology offers the same basic educational opportunity as the food technology curriculum. It includes a sequence of courses designed specifically to prepare the student for a career in the dairy industry or in the businesses providing the dairy industry with equipment, supplies and services.

Business

Students who are particularly interested in procurement and sales management, marketing and distribution, fiscal and economic aspects of the food industries may elect a 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 or dairy technology may arrange special 5-year programs leading to Bachelor of Science degrees in dairy or food technology plus one of the other selected fields.
Opportunities for Graduate Study

Food Technology

Major work is offered for the degrees Master of Science and Doctor of Philosophy in food technology. Graduate work in meat science is offered as a joint major in animal science and food technology.

Prerequisite to major graduate work is satisfactory completion of an undergraduate curriculum essentially equivalent to the food technology curriculum offered by this department. Thorough preparation in biology, chemistry, physics, mathematics (including calculus), food preservation, sanitation and processing is particularly desirable.

Major work generally will include advanced courses in bacteriology and biochemistry. Depending on the student's interest, courses in chemical engineering, food and nutrition or other appropriate subjects will also be included.

For the doctorate, the following courses are recommended: Bact. 413, B. & B. 501, Chem. 323 or 484, D.F.I. 547 (4-6 credits), D.F.I. 660 (2-3 credits) and Stat. 402.

Dairy Microbiology

Major work is offered for the degrees Master of Science and Doctor of Philosophy in dairy microbiology. Minor work is available to students majoring in other subjects.

Prerequisite to major graduate work is satisfactory completion of an undergraduate curriculum essentially equivalent to the dairy technology option offered by this department. Students from related undergraduate curricula may be admitted but will be required to take appropriate supporting undergraduate courses in dairy technology.

Suitable minor work for students majoring in dairy microbiology usually will include one or two of the following subjects: bacteriology, biochemistry, statistics, dairy science or economics.

Courses open to graduate students for minor only: 304, 306, 347, 348, 349, 350, 404, 412, 413, 414, 450, 491, 492, 493, 494, 495.

COURSES PRIMARILY FOR UNDERGRADUATE STUDENTS

110. TECHNICAL LECTURES.
(1-0) Cr. R. F.
Field of dairy and food industry, its opportunities, requirements, and organization.

114. ELEMENTS OF DAIRY AND FOOD INDUSTRIES.
(3-3) Cr. 4. F. W.S. Rosenberger.
Development and organization of the dairy and food industries; methods of processing dairy and food products, and quality control of these products.

207. JUDGING DAIRY PRODUCTS.
(0-3) Cr. 1. W. Rosenberger.
Systematic organoleptic evaluation of milk products.

304. TECHNOLOGY OF MILK FAT.
(3-0 or 3-6) Cr. 3 or 5. W.
Prerequisite: Chem 231 or 335; 350 concurrently. Nielsen.
Chemical and physical properties of milk fat. Theories of cream separation and churning. Application of chemistry and microbiology to the manufacture of butter, butter oil and related products.

305. PROCESSING AND MARKETING OF FLUID MILK.
(3-0 or 3-6) Cr. 3 or 5. S.
Prerequisite: 350. Rosenberger.
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. MANUFACTURE OF ICE CREAM AND RELATED PRODUCTS.
(3-0 or 3-6) Cr. 3 or 5. S.
Prerequisite: Chem. 231 or 335; 350. Caulfield.
Selection and processing of ingredients. Theory and practice of manufacturing procedures, based on fundamental chemical, microbiological and engineering information.

308, 309. JUDGING DAIRY PRODUCTS.
(0-3) Cr. 1 each. W.S. Rosenberger.
Systematic organoleptic evaluation of milk products.

315. DOMESTIC AND FOREIGN CHEESES.
(3-0 or 3-6) Cr. 3 or 5. S.
Prerequisite: Chem. 231 or 335; 350. Reinbold.
Application of microbiological and chemical principles to the technology of manufacturing, ripening and marketing of domestic and foreign varieties of cheese.

347, 348. DAIRY CHEMISTRY.
(8-8) Cr. 3 or 6 each. Alt. F.W. Offered 1968.
Prerequisite: 347: Chem. 211, 335. Bird.
347: Composition and changes in composition of milk in the light of milk secretion theory. The application of pH and of colloid chemistry to dairy products manufacture.
348: Importance of milk salts, milk fat, milk fat emulsion, milk proteins and milk enzymes to the processing and keeping quality of dairy products.
349. FOOD CHEMISTRY.
(B. & B. 349) See Biochemistry and Biophysics.

350. DAIRY MICROBIOLOGY.
(Bact. 350) (3-6) Cr. 5. W.
Prerequisite: Bact. 304.

404. CONDENSED AND DRIED MILK PRODUCTS.
(3 or 3-3) Cr. 3 or 4. F.
Prerequisite: Chem. 231 or 335. Caulfield.
Manufacture of condensed and dried milk products.

407. SPECIAL PROBLEMS IN DAIRY AND FOOD TECHNOLOGY.
(0-6 or 9) Cr. 2 or 3. F.W.S.S.SI.SSII.
Prerequisite: Junior classification, quality point average of 2.5 or more for preceding two quarters. Staff.
Advanced study related to the processing of dairy and other food products.
H. Honors Program.

412. FOOD PRESERVATION.
(Bact. 412) (3 or 3-4) Cr. 3 or 5. F.
Prerequisite: Bact. 304. Ayres.
Preservation, maintenance of quality of food products. Field trips.

413. MICROORGANISMS IN FOODS.
(Bact. 413) See Bacteriology.

COURSES PRIMARILY FOR GRADUATE STUDENTS, major or minor, open to qualified undergraduates

546. FOOD TECHNOLOGY.
(3-0) Cr. 3. Alt. F. Offered 1967.
Prerequisite: Bact. 304, permission of instructor. Ayres, Bird.
Selected topics in food technology presented by staff members and industry leaders in research, manufacturing and marketing.

547. FOOD TECHNOLOGY.
(2-0) Cr. 2. Yr.
Selected topics in food technology such as concentration and drying; thermal processing; food color; colloidal phenomena; rheology; flavor evaluation; process control; government regulations; additives; toxicology. Schedule of presentation will be announced.

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 1967.
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. W.
Prerequisite: 350. Reinbold.

414. FOOD. MILK AND WATER SANITATION.
(Bact. 414) (3-0 or 3-4) Cr. 3 or 5. S.
Prerequisite: Bact. 200 or 304. Walker.
Control of biological, chemical and physical environments in maintaining proper sanitation and safety of foods and water. Regulations governing sanitation. Field trips.

450. SPECIAL DAIRY MICROBIOLOGY.
(Bact. 450) Cr. 2 to 6. F.W.S.
Prerequisite: 350, junior classification, quality point average of 2.5 or more for preceding two quarters. Reinbold.
Laboratory investigations, assigned readings, and reports on microbiological problems of milk products.

491, 492, 493. FOOD PROCESSING EQUIPMENT.
(3-0 or 3-3) Cr. 3 or 4. F.
Prerequisite: Math. 102, Phys. 111, 491, 492.
Design and operation of food processing equipment considering materials handling, heat and mass transfer, fluid mechanics, steam, refrigeration and automation. Field trips.

494. 495. MANAGEMENT OF FOOD PROCESSING PLANTS.
(3-0) Cr. 3 each. W.S.
Prerequisite: 304, 305, 306. Caulfield.
Design, organization and operation of food manufacturing plants.

559. ADVANCED DAIRY MICROBIOLOGY.
(Bact. 559) (3-0 or 6) Cr. 3 or 5. F.
Prerequisite: 350. Reinbold.
Intensive study of microorganisms in milk products. Importance of beneficial and defect-producing microorganisms in manufacturing, packaging and storing milk products.

571. ADVANCED MEAT SCIENCE.

572. MICROBIOLOGY OF MEATS.
Cr. 3. Alt. S. Offered 1969.
Prerequisite: An. Scl. 470. Ayres.
Microbiological considerations in the handling of meats. Sanitation, technology, and storage life of meats.

559. ADVANCED DAIRY MICROBIOLOGY.
(Bact. 559) (3-0 or 6) Cr. 3 or 5. F.
Prerequisite: 350. Reinbold.
Intensive study of microorganisms in milk products. Importance of beneficial and defect-producing microorganisms in manufacturing, packaging and storing milk products.

571. ADVANCED MEAT SCIENCE.

572. MICROBIOLOGY OF MEATS.
Cr. 3. Alt. S. Offered 1969.
Prerequisite: An. Scl. 470. Ayres.
Microbiological considerations in the handling of meats. Sanitation, technology, and storage life of meats.

Identification and classification of microorganisms commonly found in milk products.

660. SEMINAR.
(1-0) Cr. 1. F.S. Staff.

690. RESEARCH.
A. Dairy Technology and Management.
Bird, Caulfield, Hammond, Nielsen, Reinbold.
B. Dairy Microbiology. Hartman, Reinbold.
C. Dairy Chemistry. Bird, Hammond.
DAIRY SCIENCE

For description of courses, see Animal Science.

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
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: Delma Harding, Ph.D.

Assistant Professors: Carl Vondra, Ph.D.; Philip B. Zaring, Ph.D.

Opportunities for 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 Bachelor of Science degree. Programs in distributed studies are also appropriate as preparation for teaching in secondary schools (see Teacher Education), and as preparation for graduate studies in certain interdisciplinary areas.

Opportunities for 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 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.

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 Cr. F.
Prerequisite: Ed. 305; Engl. 494 or Sp. 495 or Math. 497 or Sci. 496 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.
A. Social Studies.
B. Physical Sciences.
C. Mathematics.
D. Biological Sciences.
E. English and Literature.
F. Physical Education for Men.
G. Foreign Languages.
H. Speech.
I. Journalism.
J. Earth Science.
K. Music.

480. SPECIAL PREPARATION IN SUBJECT MATTER FOR ELEMENTARY AND SECONDARY TEACHERS.
Cr. arr. Maximum of 12 Cr. in each area listed below:
A. Social Studies.
B. Physical Sciences.
C. Mathematics.
D. Biological Sciences.
E. English and Literature.
F. Physical Education for Men.
G. Foreign Languages.
H. Speech.
I. Journalism.
J. Earth Science.
K. Music.

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.S.
Prerequisite: Junior standing and permission of instructor.

* These 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.

Associate Professor: Donald L. Biggs, Ph.D.

Assistant Professors: W. Gale Biggs, Ph.D.; Robert C. Palmquist, Ph.D.; Karl E. Seifen, Ph.D.; Lyle V. A. Sendlein, Ph.D.; Carl F. Vondra, Ph.D.

Instructors: E. Charles Guldenzopf, Jr., M.S.; Douglas C. Kent, M.S.; Musa Y. Qutub, M.S.; William P. Staub, M.A.

Opportunities for Undergraduate Study

For undergraduate curriculum in sciences and humanities, major in geology leading to the degree of Bachelor of Science see Sciences and Humanities, Curriculum.

The department offers fundamental courses in geology and geophysics designed to give the student a knowledge of the earth’s composition, processes and history. Advanced courses are offered to prepare the major for graduate studies, essential to those planning professional work in either geology or geophysics.

Undergraduate geology majors usually complete the following basic courses: 171, 202, 351, 371, 381, 431, 492 and Geophysics 440 and 9 additional credits in courses numbered above 300. The following courses are desirable as supporting work: Zool. 101, 102; Chem. 103; Engl. 205, 414; Math. 213; Phys. 223; Geophys. 341.

Students majoring in earth science education usually complete the following courses in earth science: Geol. 100, 171, 202, 261, 321, 322 or 221, 222; Geophys. 341 and 15 additional credits in courses numbered above 300.

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 who wish to estimate the amount of basic non-specialized study that may be needed.

Minor work is recommended in botany, ceramic engineering, chemistry, chemical engineering, civil engineering, mathematics, metallurgy, physics, statistics and zoology.

Opportunities for Graduate Study

The department offers major work for the degrees Master of Science and Doctor of Philosophy in geology and minor work to students taking major work in other departments. A program leading to the degree of Doctor of Philosophy with a major divided between geology and some related field is also offered. The department 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 geology should have completed the equivalent of the following courses: Geol. 202, 351, 352, 361; 371 and 381, or 431 and 492; Geophys. 440.

Minor work is recommended in chemistry, mathematics, metallurgy, physics, soils, soils engineering or zoology.

Open to graduate students for minor only are: Geol. 351, 352, 361, 371, 381, 400, 401, 402, 411, 431, 492 and Geophys. 440.

Geology

COURSES PRIMARILY FOR UNDERGRADUATE STUDENTS

100. INTRODUCTION TO GEOLOGY. (0-6) Cr. 3. F.W.S.SS.
The astronomical relationships of the earth; the nature and effects of internal and external earth processes and an introduction to the history of the earth and of life upon it. Occasional field trips will be included.
171. EARTH MATERIALS AND MAP INTERPRETATION. (3-4) Cr. 5. W. Prerequisite: 100. The classification, description and interpretation of common rock-forming minerals, rocks and fossils. An introduction to the analysis of topographic and geologic maps.

202. SUMMER FIELD WORK. Cr. 8-12. SS. An eight-week summer camp, required of all geology majors. Areal mapping, structural and stratigraphic analyses. Written report with appropriate illustration required.

203. SPRING FIELD TRIP. Cr. 1 each time taken. W. or S. Prerequisite: 202. 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.

221. CULTURAL GEOGRAPHY—EUROPEAN AND AMERICAN. (3-0) Cr. 3. W. A study of the climate and physical geography of Europe, North, Central, and South America and their influence on the cultural development of man in those areas. Not acceptable for credit toward Sciences and Humanities group III.

222. CULTURAL GEOGRAPHY—AFRICAN, ASIAN, AUSTRALIAN AND PACIFIC ISLAND. (3-0) Cr. 3. S. A study of the climate and physical geography of Asia, Africa, Australia, and the Pacific Islands and their influence on the cultural development of man in those areas. Not acceptable for credit toward Sciences and Humanities group III.

261. 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.

301. GEOLOGY FOR ENGINEERS. (2-3) Cr. 3. F. Fundamentals of the science and engineering application. Field trips.

303. UNDERGRADUATE SEMINAR. Cr. 1. F.W.S.

321. WORLD GEOGRAPHY. (3-0) Cr. 3. F. Prerequisite: 100. The character and distribution of the elements comprising man’s physical environment and the inter-relationships of the man-environment system. Not acceptable as credit toward a major in geology. Not acceptable for credit toward Sciences and Humanities group III.

322. ECONOMIC GEOLOGY. (3-0) Cr. 3. W. Prerequisite: 100. The character and distribution of natural resources; their influence on man and their utilization by man. Not acceptable as credit toward a major in geology. Not acceptable for credit toward Sciences and Humanities group III.

351. MINERALOGY. (2-6) Cr. 4. F. Prerequisite: Chem. 102. Geochemistry of silicates and other rock-forming minerals; determinative mineralogy.

352. 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.

361. INVERTEBRATE PALEONTOLOGY. (2-6) Cr. 4. F. Prerequisite: 100 or 261. Characteristics and relationships of invertebrates of fossil record; their use in historical geology. Field trips.

371. PETROLOGY. (2-6) Cr. 4. S. Prerequisite: 171, 352. Physiochemical properties and behavior of rocks as a function of their environment. 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. 402. GEOLOGIC EVOLUTION OF NORTH AMERICA. (3-0) Cr. 3 each. W.S. Prerequisite: 381. Structural and stratigraphic evolution of North America: 401, Pre-Cambrian and Paleozoic: 402, Mesozoic and Cenozoic.

407. GEOLOGIC INTERPRETATION OF AERIAL PHOTOGRAPHS. (1-6) Cr. 3. S. Prerequisite: 202. Hussey. 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: 381. 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.
COURSES PRIMARILY FOR GRADUATE STUDENTS, major or minor, open to qualified undergraduates

501. SEMINAR.
Cr. 1 each time elected. F.W.S. Staff.

512. ADVANCED ECONOMIC GEOLOGY.
(3-0) Cr. 3. Alt. W.
Prerequisite: 411.
Description of Courses
Geology applied to mining, significant deposits and districts

531. QUATERNARY GEOLOGY.
(3-0) Cr. 3. Alt. S. Offered 1968.
Prerequisite: 431 and permission of instructor. 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

535. GROUNDWATER GEOLOGY.
(2-3) Cr. 3. Alt. W.
Prerequisite: C.E. 304, Geophys. 440, Sendlein.
Occurrence and distribution of subsurface water; nature of conducting media

551 ADVANCED MINERALOGY.
(2-3) Cr. 3. Alt. S. Offered 1968.
Prerequisite: 352. Biggs.
Structural, chemical and paragenetic relationships of common rock-forming minerals

561. VERTEBRATE PALEONTOLOGY.
(3-3) Cr. 4. Alt. W. Offered 1968.
Prerequisite: 361. Zool. 224 or equivalent.
Permission of instructor. Vondra.
The cranial, dental and postcranial morphology, taxonomy, evolution and distribution of fossil vertebrates with emphasis on the mammals

COURSES FOR GRADUATE STUDENTS, major or minor

690. SPECIAL TOPICS.
Cr. 1 to 3 each time taken.
B Stratigraphy. Vondra.
C Paleontology. Vondra.
E Dynamic and Structural Geology. Hussey, Lemish, Roy.
F Geochemistry. Biggs, Lemish.
G Geophysics. Sendlein.
H Water Resources. Hussey, Sendlein.
I Rock Deformation. Seifert.

695. RESEARCH.
Cr. 1 to 3 each time taken.
B Stratigraphy. Vondra.
C Paleontology. Vondra.
F Geochemistry. Biggs, Lemish.
G Geophysics. Sendlein.
H Water Resources. Hussey, Sendlein.
I Rock Deformation. Seifert.

Geophysics

COURSES PRIMARILY FOR UNDERGRADUATE STUDENTS

206. AGRICULTURAL METEOROLOGY
(Agron. 206) See Agronomy.

309. INTRODUCTION TO GEOPHYSICS.
(3-0) Cr. 3. S.
Prerequisite: Geol. 202, Phys. 113 or 223.
Application of physical principles to the determination of subsurface rock structure and/or boundaries. Area of study includes seismology, gravimetry, magnetometry, and the techniques of electrical and radioactivity surveying.
Opportunities for Undergraduate qualified undergraduates to specialize in the study of international affairs

COURSES found under the heading


Opportunities for Undergraduate Study

Programs of study offered in both the College of Agriculture and the College of Sciences and Humanities are outlined in this section. Information for students who wish to specialize in the study of international affairs while majoring in economics may be found under the heading International Service Programs.
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.

A student preparing for the study of law may complete three years of study under the agricultural business curriculum, followed by one year in a recognized law college, after which the degree Bachelor of Science will be awarded by Iowa State University.


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 students' objectives. Among the programs are labor and industrial relations, pre-law, general business, international trade and development, urban and regional economics, consumer economics, and government service and research. 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.

Opportunities for 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.

Prerequisite to major graduate work in the department is the completion of undergraduate work in economics, mathematics, statistics, sociology and other social science and technical subjects, substantially equivalent to that required of undergraduate students majoring in agricultural business or economics, consumption economics, general economics or industrial economics at this institution.

The foreign language requirement for the degree Master of Science may be waived upon recommendation of the department head.

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 Econ.
A twelve to twenty-four weeks of full-time observation and supervised experience in the employ of selected agricultural businesses. Not more than 6 credits will apply toward a B.S. degree.

241. 242. 243. PRINCIPLES OF ECONOMICS
(3-0) Cr. 3 each. F.W.S.SSI.

* 292. MARKETING BUSINESS OPERATIONS
(3-2) Cr. 4. F.S.
Prerequisite: 6 credits in Econ.
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 plans. Visits to representative businesses.

304. MONEY AND BANKING
(3-0) Cr. 3. F.W.S.SSI.
Prerequisite: 242.
Principles of money and credit. Principles of bank management, including the banker-customer relationship, non-bank financial institutions, central banking and monetary policy.

305. LABOR ECONOMICS AND LABOR RELATIONS
(3-0) Cr. 3. F.W.S.SSI.
Prerequisite: 242.

306. COMPARATIVE ECONOMIC SYSTEMS
(3-0) Cr. 3. F.
Prerequisite: 242.
Comparison of the economic theories of communism, democratic socialism, fascism, capitalism and relevant alternative forms of economic organization, operation and performance of Russian, American, British and other economies. Choice of systems at different levels of economic and industrial growth.

307. 308. PRICES AND RESOURCE ALLOCATION
(3-0) Cr. 3 each. 307: F.W.SSI; 308: W.S.

313. CONSUMPTION ECONOMICS
(3-0) Cr. 3. S.
Prerequisite: Two quarters of economics. Consumer's choice, consumption and the market, standards of living, measurement of consumption, effects of technological change.

* 329. FARM ACCOUNTING AND BUSINESS ANALYSIS
(2-2) Cr. 3. F.W.S.
Prerequisite: 4 credits in Econ.
Purpose and methods of keeping farm records, 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.SSI.
Prerequisite: 242.
A student cannot count credit for both 130 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.S.SSI.
Prerequisite: 242.
Estimating prospective demands for farm products in relation to supplies, improving the accuracy of the system that reflects consumers' demands to producers, reducing the costs and increasing the efficiency of marketing.

* 403. MARKETING LIVESTOCK AND MEAT
(Agr.Sci. 403) (3-0) Cr. 3. S.
Prerequisite: 242.
The demand, supply, and distribution of livestock and meat. Analysis of changes in marketing methods; grades, values, prices and costs. One all-day field trip.

405. PUBLIC FINANCE AND FISCAL POLICIES
(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.
Prerequisite: 242.
Business investment fluctuations and other determinants of national income and employment. Government spending, taxing and monetary policies for economic stabilization.

410. COMPETITION 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: 307. 409; or 242 and permission of instructor.
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.
506. INTERMEDIATE MACROECONOMIC ANALYSIS. (3-0) Cr. 3. S.S.SII.  
Prerequisite: 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, Wicksellian and Keynesian models.

507, 508. INTERMEDIATE MICROECONOMIC ANALYSIS. (3-0) Cr. 3 each. 507 F.W. SSI; 508 W.S. SSI.  
Prerequisite: 308. Fletcher, Winkelmann, Cheng  
Analysis of production function, behavior of firms in perfect competition, theory of consumption, concepts of optimal allocation of resources, distribution of income. Behavior of firms in nonperfect competition.

510. LAND RESOURCE USE AND CONSERVATION. (3-0) Cr. 3. Alt. W. and SS. Offered SS. 1968.  
Prerequisite: 308 or 434. Thomas, Timmons  
Land resource classification and economic limits of disinvestment in water, soil, forests, minerals, etc. Meaning of conservative and use limits. Economic principles applied to land resources. Appraisal of public controls, public programs and group action.

512. AGRARIAN REFORM AND ECONOMIC DEVELOPMENT. (3-0) Cr. 3. S.  
Prerequisite: 307 or 334. Timmons  
Meaning of economic development, under-development, overpopulation, agrarian structures as obstacles to economic development. Improving agrarian structures through national, regional and United Nations actions.

520. FOOD ECONOMICS. (H.Mgt. 520) See Home Management.

531. AGRICULTURAL MARKET ORGANIZATION AND BUSINESS BEHAVIOR. (3-0) Cr. 3. P.  
Prerequisite: 507. 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.  
Prerequisite: 507. Fletcher, Doak  
Current problems in agricultural markets and marketing; integration of theory, models, techniques and data in problem formulation; role of information in decision processes; research objectives, organization and financing—state, federal and industry; dissemination and application of research findings.

533. RESEARCH DESIGN IN AGRICULTURAL MARKETING. (3-0) Cr. 3. S.  
Prerequisite: 507. Fletcher, Doak  
Current problems in agricultural marketing; integration of theory, models, techniques and data in problem formulation; role of information in decision processes; research objectives, organization and financing—state, federal and industry; dissemination and application of research findings.

536. BUSINESS FLUCTUATIONS. (3-0) Cr. 3. Alt. F. Offered 1969.  
Prerequisite: 409 or 506. Brady, Starleaf  
General fluctuations in production, employment, prices, and incomes; their scale and importance; principal explanations suggested, proposed remedies.

537. LINEAR ECONOMIC MODELS. (3-0) Cr. 3. F.  
Prerequisite: 507. Math. 102 or 104. Ladd  
Selected applications of mathematics to economic problems; includes game theory, linear programming, and input-output analysis.

538. ELEMENTARY ECONOMETRIC STATISTICS. (Stat. 538) See Statistics.


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.

548. QUANTITATIVE AGRICULTURAL PRICE ANALYSIS. (3-0) Cr. 3. F. Prerequisite: 307. Doak, Scott, Shepherd. Measurement of supply and demand for agricultural products. Integration of government reports into outlook information for planning purposes by agricultural producers and marketing firms. Collection and analysis of price and quantity information.

550. INDUSTRIAL STRUCTURES AND COMPETITION. (3-0) Cr. 3. F. Prerequisite: 508. Fletcher, Merrill. Business concentration in the American economy; structure 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.

551. MONETARY THEORY. (3-0) Cr. 3. F. Prerequisite: 409 or 506. Christian, Luckett, Stephenson. The classical quantity theory of money; the Keynesian monetary theory; classical, Swedish, and Keynesian theories of interest; the "new" quantity theory of money; the Gurley-Shaw theory of finance; the portfolio approach to monetary theory.

552. ADVANCED MONEY AND BANKING. (3-0) Cr. 3. W. Prerequisite: 304. Christian, Luckett, Stephenson. Theory and structure of commercial banking, the money and capital markets, financial intermediaries, and the Treasury with respect to central banking and monetary policy.

554. THE PUBLIC ECONOMY. (3-0) Cr. 3. F. Prerequisite: 507. Meyer. Determination of public expenditure and tax policies; tax structures and shifting and incidence of taxes; policies and methods of income redistribution; fiscal policies and economic stabilization.

555. ADVANCED INTERNATIONAL ECONOMICS. (3-0) Cr. 3. W. Prerequisite: 307. Thorbecke, Cheng. 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. F. Prerequisite: 508. Maki, 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; 506 and 555 recommended. Cheng, Luckett. 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.

560. WELFARE ECONOMICS. (3-0) Cr. 3. F. Prerequisite: 508. Holdren. Pareto optimality and the various compensation principles. The axiomatic approach to the derivation of social welfare functions. The relation between ethics and welfare economics.

561. AGRICULTURAL RESOURCE AND INCOME PROBLEMS. (3-0) Cr. 3. F. Prerequisite: 506. Kaldor. Analysis of adjustment, instability and income problems and their interrelationships; forces of agricultural dis-equilibrium, adaptability of the farm industry; sources of short-run price and income instability; farm family income problems related to structural imbalance and inadequate resource allocation.

562. AGRICULTURAL PRICE AND INCOME POLICY. (3-0) Cr. 3. W. Prerequisite: 561. Ball, Kaldor, Shepherd. 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. (Govt. 563) (3-0) Cr. 3. S. Prerequisite: 447. Govt. 473 recommended. Talbot, Kaldor. Politico-economic analysis of current agricultural policy issues. A major issue selected for analysis in depth. Underlying value judgments and relationships identified and analyzed. Political acceptability of alternative solutions appraised.

564. STATE-LOCAL FINANCE. (3-0) Cr. 3. W. Prerequisite: 405 or 554. Govt. 310 recommended. Prescott, Meyer. Theory of tax expenditure systems in a federal fiscal system. Functions of municipal and special assessment districts. Functions of state government; taxing powers; legal basis for expenditures, interstate variations and trends in financing. Theory of grants-in-aid; welfare implications of resource transfers; effects of attached general purpose grants. State-local and federal-local fiscal interdependencies.

566. URBAN ECONOMICS. (3-0) Cr. 3. W. Prerequisite: 507. Faden. History of world urban development, economic foundations of the city, agglomeration forces, linkage; theories of city growth—ring theories, sectorial 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; city and metropolitan planning, design and renewal.
570. ECONOMIC DEVELOPMENT AND GROWTH.
(3-0) Cr. 3. S.
Prerequisite: 508. Thorbecke, Sengupta.
Determinants of real income, resources and their productivity in developed and underdeveloped areas. Capital formation and allocation. Investment criteria; social marginal productivity; employment absorption. Economic growth models. Population factors in economic development. Balance of payment problems of developing countries.

576. REGIONAL ECONOMIC PLANNING.
(3-0) Cr. 3. S.
Prerequisite: 307. Maki, Prescott.
Regional economic aspects of resource management; role of economic information in physical planning. Problems of public policy for control and use of natural and human resources in regional development. Application of systems analysis to public planning in river basin and metropolitan regions.

588. FAMILY FINANCE.
(H. Mgt. 588) See Home Management.

590. ECONOMICS OF COLLECTIVE BARGAINING.
(3-0) Cr. 3. Alt. S. Offered 1969.
Prerequisite: 508. Davey, Palomba.
Theories of bargaining power. Economic effects of collective bargaining at both the microeconomic and macroeconomic levels. Union wage policy and employment effect. Wage-price-profit-productivity relationships. Economic aspects of adjustment to technological change through collective bargaining.

591. COMPARATIVE TRADE UNIONISM.
(3-0) Cr. 3. Alt. S. Offered 1968.
Prerequisite: 508. 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.

592. ADVANCED LABOR MARKET ANALYSIS.
(3-0) Cr. 3. S.
Prerequisite: 307, or consent of instructor. Jakubauskas.
Advanced research and analysis of current problems in wages and labor markets, unemployment and underemployment, and changes in the industrial and occupational composition of the labor force.

599. SPECIAL TOPICS.
Cr. 1 to 5 each time taken. F.W.S.
- A. Agricultural Economics. Staff
- B. Economics.
- *Offered by the College of Agriculture. Courses not marked by an asterisk are offered by the College of Sciences and Humanities.

COURSES FOR GRADUATE STUDENTS, major or minor

605, 606. HISTORY OF ECONOMIC DOCTRINES.
(3-0) Cr. 3. each. Alt. F.W. Offered 1968.
Prerequisite: 506, 508. Luckett, Starleaf.
Principal figures in the development of economic ideas; contribution of each period of economic thought. 505. The Mercantilists to the Classical School, inclusive. 606: Critics of the Classical School to J. M. Keynes.

614, 615. ADVANCED THEORETICAL ANALYSIS.
(3-0) Cr. 3 each. 614, F., 615, W.
Prerequisite: 506. VanMoeske, Sengupta.
614: Axiomatic formulation of material scarcity. Utility and revealed preference. Stable general equilibrium of consumer and firm. 615: General equilibrium: existence and Pareto optimality; activity-analytic approach; dynamic intersectoral balance; turnpike theorems. Application to work trade extension to imperfect knowledge.

616. ADVANCED MACROECONOMIC THEORY.
(3-0) Cr. 3. S.
Prerequisite: 506. Brady, Starleaf.
Macroeconomics; relations between monetary theory and general equilibrium theory.

630. ADVANCED LAND ECONOMICS.
(3-0) Cr. 3. F.
Prerequisite: 308 or 434. Timmons, Hart.

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: 507. 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, prices and asset control; uncertainty and expectations.

642. RESOURCE EFFICIENCY AND ALLOCATION IN AGRICULTURE.
(3-0) Cr. 3. W.
Prerequisite: 641. Heady.
Opportunities for Graduate Study

For undergraduate curricula in agricultural education and in industrial education leading to the degree Bachelor of Science, see College of Agriculture, Curricula.

Opportunities for Graduate Study

The department 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, agricultural education and minor work in education and in the field of agricultural economics.
Courses in Education

COURSES PRIMARILY FOR UNDERGRADUATE STUDENTS

110. FRESHMAN PROBLEMS.
(1-0) Cr. R.F. W.
A. Agricultural Education
B. Industrial Education.
Opportunities in education; qualifications; personal development; how to study. Required of all students majoring in agricultural education and industrial education

204. FOUNDATIONS OF AMERICAN EDUCATION.
(3-0) Cr. 3. F.W.S.SSI,SSI.
Place of education in democracy; American public school system; modern objectives of education; legal, personal and professional qualifications for teaching.

305. METHODS OF TEACHING.
A: (3-0) Cr. 3. F.W.S.SSI,SSI. B: (0-2) Cr. 1. F.W.S.SSI.
Prerequisite: 204, classification in Psych. 333, enrollment in approved teacher education program, junior classification. Schloerke.
A: Current educational methods and their subsequent utilization in the classroom. Special emphasis on unit planning, objective formation, and teaching techniques. B: Audio-visual Laboratory

375. THE TEACHING OF READING.
(5-0) Cr. 5. F.W.S.SSI.
Prerequisite: 204, Psych. 333, C.D. 366. 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.

417. OBSERVATION AND SUPERVISED TEACHING.
Cr. 3-12. F.W.S.
Prerequisite: 305, special methods. Observation and supervised teaching in public schools and junior college.

426. PRINCIPLES OF SECONDARY EDUCATION.
(3-0) Cr. 3. F.W.S.SSI.
Prerequisite: 305 or equivalent. Manatt. 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.

490. SPECIAL PROBLEMS.
Cr. 1 to 6. F.W.S.

COURSES PRIMARILY FOR GRADUATE STUDENTS, major or minor, open to qualified undergraduates

515. EVALUATION OF EDUCATIONAL OUTCOMES.
(0-2) Cr. 2. W.SS. Howe.
Prerequisite: 15 credits in Ed. Methods of evaluating educational outcomes; types of tests and their construction, use and interpretation of educational measures in teaching.

530. PRINCIPLES AND PRACTICES OF GUIDANCE.
(2 or 3-0) Cr. 2 or 3. F.S.SSI.
Prerequisite: 15 credits in Ed. and Psych., including 426, Psych. 333. Bryan, Brown, 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 3-0) Cr. 2 or 3. W. and SSI.
Prerequisite: 530, Psych. 440. Bryan, Brown, 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. S.SSI.
Prerequisite: Education 530. Brown. 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; techniques used and differential factors employed in organizing the elementary school program.

533. COUNSELING HIGH SCHOOL STUDENTS.
(2-2) Cr. 3. W.SSI.
Prerequisite: 530, 531. Bryan, Brown, Hopper.
Use of individual and environmental information in the school counseling situation.
534. ADMINISTRATION OF THE GUIDANCE SERVICES.  
(2 or 3-0) Cr. 2 or 3. F. S.SI.  
Prerequisite: 15 credits in Ed. Brown, Hopper.  
Administrative principles and practices in organizing and implementing the guidance services.

535. GROUP PROCEDURES IN GUIDANCE.  
(3-0) Cr. 3. W. S.SI.  
Prerequisite: Education 533 and permission of the Instructor. Hopper.  
Methods for organizing, maintaining, conducting and evaluating group guidance and group counseling sessions.

536. ADULT EDUCATION.  
(1 or 2-3) Cr. 2 or 3. F.  
Prerequisite: 15 credits in Ed. 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.SI.  
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.SSI.  
Prerequisite: 5 credits in Ed. Manatt, Engel.  
Philosophy and purposes of education in a democratic society. Basic principles of school administration. Analysis of the nature and function of units of education at local, intermediate and state levels; principles and procedures for their reorganization.

542. THE COMMUNITY PROGRAM OF SECONDARY EDUCATION.  
(2 or 3-0) Cr. 3. W. S.SI.  
Prerequisite: 426. Dills.  
The academic and vocational program of community high schools; extra-class activities, education programs for post-high school youth and adults, local community resources as curriculum content; curriculum revision.

543. THE ADMINISTRATION OF SCHOOL PERSONNEL.  
(2 or 3-0) Cr. 2 or 3. W.SSI.  
Prerequisite: 15 credits in Ed. Manatt, Engel.  
Selection and organization of the teaching staff, personnel policies, stimulation of professional growth, management of non-professional employees. Nature of leadership.

544. ADMINISTRATION OF MATERIAL FACILITIES IN EDUCATION.  
(2 or 3-0) Cr. 2 or 3. S.SSI.  
Prerequisite: 15 credits in Ed. Boyles, Manatt, Engel.  
Care of buildings and grounds, community use of school plant, management of equipment and supplies; provisions for office management, school bus transportation, libraries, audio-visual aids and teaching materials.

545. THE COMMUNITY PROGRAM OF ELEMENTARY EDUCATION.  
(2 to 4-0) Cr. 2 to 4. F.SSI.  
Prerequisite: 15 credits in Ed. Shea.  
Problems of organization and administration of the elementary school program in relation to current theories and practices. Review of state courses of study; areas of living education; the fine arts, elementary school extra-class activities; community resources.

546. SCHOOL BUSINESS MANAGEMENT.  
(3-0) Cr. 3. W.SSI.  
Prerequisite: 541. Boyles, Manatt, Engel.  
Fiscal administration of local school systems, budgeting; financial accounting, auditing school accounts.

547. SUPERVISION OF INSTRUCTION IN ELEMENTARY AND SECONDARY SCHOOLS.  
(3-0) Cr. 3. S.SI.  
Prerequisite: 15 credits in Ed. Dilts, Shea, Manatt.  
Purposes of democratic educational supervision; review of modern elementary school and secondary school methods of teaching, common techniques of supervision; unique methods of teaching in arithmetic, the languages, arts, science and social studies; evaluation of teaching effectiveness.

548. EDUCATIONAL POLICY-MAKING AND INTERPRETATION.  
(3-0) Cr. 3. W.SSI.  
Prerequisite: 541. Manatt, Engel.  
Historical and legal bases of educational government in the United States, current issues in educational policy-making at the local, state, and national levels, problems of implementing policy and interpreting educational programs to the community.

549. SCHOOL BUILDINGS.  
(3-0) Cr. 3. S.  
Prerequisite: Ed. 541. Boyles.  
Assessment of need for new buildings, selection and acquisition of site, selection of architect, educational specifications, construction of new buildings.

550. AUDIO-VISUAL METHODS IN EDUCATION.  
(2-3) Cr. 3. W.SSI.  
Prerequisite: 305.  

551. OCCUPATIONAL INFORMATION.  
(3-0) Cr. 3. F.W.SSI.  
Prerequisite: 15 credits in Ed. and Psych. Bryan, Canute, Brown, Hopper.  
Methods and techniques of occupational 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.

552. 553. EDUCATIONAL STATISTICS.  
(3-0) Cr. 3 each. F.W.SSI.SSII.  
Prerequisite: 15 credits in Ed. Howe.  
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. (2-0) or (3-0) Cr. 2 or 3. W.SS. Prerequisite: Ed. 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, and business administration.

556. ADMINISTRATION OF AREA VOCATIONAL-TECHNICAL SCHOOLS AND COMMUNITY COLLEGES. (3-0) Cr. 3. W.SS. Prerequisite: Ed. 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.SS. Fundamental factors in the development of higher education, contemporary issues and practices, trends and problems.

561. METHODS OF COLLEGE TEACHING. (2 or 3-0) Cr. 2 or 3. W. Lagomarcino, Kizer. Basic principles of educational 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, inter-relationship of general and specialized education, liberal education, professional education.

563. COLLEGE PERSONNEL POLICIES AND PRACTICES. (3-0) Cr. 3. S.SSII. An examination of personnel problems in college, preparation and inservice development, salaries, promotion, academic freedom and tenure, leaves; retirement.

575. FUNDAMENTALS OF SCHOOL LAW. (3-0) Cr. 3. S.SS167. Prerequisite: 541, 543. Engel, Manatt. Fundamentals and principles of law as related to the state and education, reorganization, liability, board procedures, pupil regulation, conditions of employment.

584. HISTORY OF EDUCATION. (3-0) Cr. 3. S. Prerequisite: 15 credits in Ed. Kizer. Historical foundations of education in Europe and the United States of America.

585. COMPARATIVE EDUCATION I: EUROPE AND THE ENGLISH SPEAKING COUNTRIES. (3-0) Cr. 3. F.SS.

COURSES FOR GRADUATE STUDENTS, major or minor

601. PHILOSOPHY OF EDUCATION. (3-0) Cr. 3. F.SSII. Prerequisite: 15 credits of graduate work in Ed. Kizer. Examination of contemporary positions in education from divergent philosophical perspectives; modes by which philosophical resources can be brought to bear critically on educational problems and issues.

602. CURRENT EDUCATIONAL MOVEMENTS.

560. PHILOSOPHY OF EDUCATION. (3-0) Cr. 2 or 3. W. Prerequisite: 15 credits in Ed. Kizer. A study of the principal issues and movements in the development of American education in the twentieth century.

603. PHILOSOPHICAL IDEAS IN AMERICAN EDUCATION. (3-0) Cr. 3. S.SS. Prerequisite: 601. Kizer. An intensive analysis of selected philosophical issues and their bearing on educational theory and practice.
Courses in Agricultural Education

COURSES PRIMARILY FOR UNDERGRADUATE STUDENTS

211. OBSERVATION AND SURVEY OF PROGRAM OF EDUCATION IN AGRICULTURE.
(0-3) Cr. 1 each. A: S.; B: F.S.
A. Agricultural Education. Visitation of high school departments of agriculture. Survey of day school, young and adult farmer programs. Field trips. B. Extension Education. Visitation 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.
(2-3) Cr. 3. F.S.
Prerequisite: 305.
Departments are visited to observe programs and results.

423. METHODS OF TEACHING VOCATIONAL AGRICULTURE IN HIGH SCHOOL.
(3-3) Cr. 4. F.W.
Prerequisite: 321.
Course organization, methods, farm programs, employment training and Future Farmers of America activities. Departments visited to observe programs and results.

424. YOUNG FARMER AND ADULT EDUCATION IN AGRICULTURE.
(3-3) Cr. 4. F.W.
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.
Cr. 3 to 12. F.W.
Prerequisite: 321.
Open only to Ag. Ed. majors. Three to nine weeks of full-time observation and supervised teaching in public schools. To be scheduled with "as arranged" courses and special sections.

466. ADMINISTRATION AND ORGANIZATION OF EXTENSION EDUCATION.
(3-0) Cr. 3. F.W.
History and philosophy of extension education in agriculture and home economics, plans of organization; extension programs; relationships with other agencies, selection and training of extension personnel.

490A. SPECIAL PROBLEMS IN AGRICULTURAL EDUCATION.
F.W.S.
For description of course see courses in General Education.

COURSES PRIMARILY FOR GRADUATE STUDENTS, major or minor, open to qualified undergraduates

538. YOUNG FARMER EDUCATION IN AGRICULTURE.
(1 or 2-3) Cr. 2 or 3. S.S.S.I.
Prerequisite: 424.
Problems and needs of beginning farmers, survey techniques, use of advisory councils, administrative relationship problems and evaluation of programs leading to establishment in farming. Departments are visited to observe programs and results.

539. FARMING PROGRAMS AND EMPLOYMENT TRAINING IN VOCATIONAL AGRICULTURE.
(3-0) Cr. 3. F.S. Off-Campus.
Prerequisite: 423, 424. Bundy.

<table>
<thead>
<tr>
<th>Courses</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>Courses in Industrial Education</td>
<td>Analysis of farming and other occupational opportunities in agriculture in individual communities, state and nation. Methods in analyzing individual situations and in program planning.</td>
</tr>
<tr>
<td>590A. SPECIAL TOPICS IN AGRICULTURAL EDUCATION</td>
<td>Cr. 1 to 5. F.W.S.</td>
</tr>
<tr>
<td>Prerequisite: 15 credits in Ed. Bundy. McClelland.</td>
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<tr>
<td>591A WORKSHOP IN AGRICULTURAL EDUCATION</td>
<td>Cr. 1 to 5. F.W.S.</td>
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<tr>
<td>Prerequisite: 15 credits in Ed. Bundy, McClelland.</td>
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</tbody>
</table>

Courses for Graduate Students, major or minor

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Title</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>604</td>
<td>THE COMMUNITY SCHOOL PROGRAM OF AGRICULTURAL EDUCATION</td>
<td>1-6</td>
</tr>
<tr>
<td>Prerequisite: 253, 254, 255, 256.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Organization of vocational agriculture in the community and technical school; curriculum; supervised farming programs, student activities, and evaluation of results and employment experiences.</td>
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<tr>
<td>690</td>
<td>RESEARCH.</td>
<td>F.W.S. Bundy</td>
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<tr>
<td>Cr. 1 to 5.</td>
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</tbody>
</table>

Courses in Industrial Education

Courses Primarily for Undergraduate Students

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>105</td>
<td>TECHNOLOGY AND APPLICATION OF FINISHING MATERIALS.</td>
<td>1-6</td>
</tr>
<tr>
<td>Prerequisite: 423. Bundy.</td>
<td></td>
<td></td>
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<tr>
<td>A technical approach to finishing materials and techniques used in schools and industries; testing and evaluating finishes, experimentation and introductory research.</td>
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<tr>
<td>106</td>
<td>EXPLORATION AND FUNDAMENTAL FABRICATION OF WOOD.</td>
<td>1-6</td>
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<tr>
<td>Prerequisite: I.Ed. 105.</td>
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<tr>
<td>Introduction to hand tools, basic machines, pattern making, home construction and wood technology in current practice.</td>
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<tr>
<td></td>
<td>ELECTRICITY II.</td>
<td>1-6</td>
</tr>
<tr>
<td>Application of fundamental principles of design in planning of industrial arts projects. Field trips to industries, museums, etc.</td>
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<tr>
<td>207</td>
<td>CRAFTS.</td>
<td>1-6</td>
</tr>
<tr>
<td>Cr. 3. F.W.</td>
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<tr>
<td>Craft materials and their application to industrial arts, shopwork; principles and techniques of crafts suitable for industrial art craft classes, such as plastics, leather, gem cutting, etc.</td>
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<tr>
<td>250</td>
<td>INDUSTRIAL ARTS DESIGN.</td>
<td>3-0</td>
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<tr>
<td>Application of fundamental principles of design in production of industrial arts projects.</td>
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<tr>
<td>251</td>
<td>ELECTRICITY I.</td>
<td>3-0</td>
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<tr>
<td>Cr. 3. F.W.</td>
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<tr>
<td>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.</td>
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<tr>
<td>253</td>
<td>ELECTRICITY II.</td>
<td>3-0</td>
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<tr>
<td>Cr. 3. W.S.</td>
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<tr>
<td>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.</td>
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<tr>
<td>254</td>
<td>BASIC METAL PROCESSES.</td>
<td>1-6</td>
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<tr>
<td>Cr. 3. F.S.SIII.</td>
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<tr>
<td>Principles and practices of bench metalwork; layout sawing, chiseling, filing, drilling, threading, hardening, tempering, casting.</td>
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<tr>
<td>255</td>
<td>SHEET METAL FABRICATION.</td>
<td>1-6</td>
</tr>
<tr>
<td>Cr. 3. F.S.SIII.</td>
<td></td>
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<tr>
<td>Principles and practices involved in the use of sheet metal tools, equipment and materials, forming and fabrication, layout techniques.</td>
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</tr>
</tbody>
</table>
350. SCHOOL SHOP SAFETY EDUCATION
(3-0) Cr. 3. F.S.SSI
Prerequisite: Junior classification. Sherick.
Analysis of accidents and accident prevention in the school shop, methods of initiating an effective safety program. First-aid instruction.

352. ELECTRICITY III
(1-6) Cr. 3. F.W.S.
Prerequisite: 252. Sherick.
Basic principles and practices involved in electric motor, generator and appliance construction, motor rewind and electrical appliance repair as applied in industrial education laboratory work.

353. CARE OF EQUIPMENT
(0-6) Cr. 2. F.W.S.
Prerequisite: F. Ed. major, junior standing. Techniques and methods involved in maintenance and repair of shop tools and machinery.

354. TEACHING SECONDARY SCHOOL DRAWING
(1-6) Cr. 3. W.S.
Prerequisite: 6 credits of drawing. Martin. Organization of subject matter, methods, teaching aids, and evaluation, as applied to the teaching of drawing in high schools.

356. MACHINE METALS II
(1-6) Cr. 3. F.W.S.SS168.
Prerequisite: 256.
Advanced theory and laboratory practice in the setup and operation of machine tools, as applied to industrial education.

357. ELECTRONICS I
(1-6) Cr. 3. F.S.SS168.
Prerequisite: 253, 255. Sherick.
Basic principles of radio construction, service and repair as applied to the secondary school industrial electronics program. Use of the oscilloscope, signal generators, signal tracer and other test equipment used in radio.

358. MODERN MATERIALS, DESIGN AND CONSTRUCTION
(1-6) Cr. 3. F.W.S.
Prerequisite: 105, 106, 205. Martin, Weede. Advanced design and construction as applied to furniture, cabinet making, sporting equipment and specialized items.

361. POWER MECHANICS II
(1-6) Cr. 3. F.W.S.SS168.
Prerequisite: 261. Mr. Diedrick.
Automobile engine overhaul procedures and techniques, including proper use of tools, equipment, and manufacturers' manuals, adjustments, measurements, development of supplementary instructional materials.

364. POWER MECHANICS IV
(1-6) Cr. 3. F.S.SS.
Prerequisite: 261.
A study of automobile suspension, braking and power transmission systems, familiarization of these by work on representative models.

368. POWER MECHANICS III
(1-6) Cr. 3. F.S.SS168.
Prerequisite: 261. Diedrick.
Automobile engine tune-up and electrical service. Theory of the automobile electric and fuel systems. Application of theory in troubleshooting and repairing these systems. Developing and presenting instructional materials and techniques.

100. ELECTRONICS II
(1-6) Cr. 3. F.W.S.
Prerequisite: 357. Sherick.
Basic television construction, service and repair. Use of the oscilloscope, vacuum tube-volt-ohm milliammeter and other test equipment used in television repair. The basic principles of television and frequency modulation as applied to the secondary school industrial education electronics program.

410. SHOP PLANNING AND ORGANIZATION
(3-0) Cr. 3. S. Carver, Weede, Martin. Planning of school shops, selection and location of equipment, estimate of cost. Trips to secondary schools.

415. METHODS OF TEACHING INDUSTRIAL ARTS
(3-0) Cr. 3. S.SSI. Carver, Martin. Methods and techniques of teaching industrial arts, objectives, organization of subject matter, relationships, and evaluation. Field trips to schools.

416. OBSERVATION AND SUPERVISED STUDENT TEACHING IN INDUSTRIAL EDUCATION
Cr. 3 to 12. F.W.S.
Prerequisite: 415. Carver. Observation and supervised teaching in public schools.

456. THE GENERAL SHOP
(1-6) Cr. 3. F.W.
Prerequisite: Junior classification. Carver, Wiener.
Shop organization and procedure, selection of units, projects and teaching aids; designing and developing of suitable problems.

190. SPECIAL PROBLEMS IN INDUSTRIAL EDUCATION
Cr. 1 to 5. F.W.S. Staff.
Prerequisite: Junior classification. Quality point average of 2.5 or more for two preceding quarters.
H Honors Program
G Technical Training

COURSES PRIMARILY FOR GRADUATE STUDENTS, major or minor, open to qualified undergraduates

510. TECHNIQUE OF TEACHING TRADES AND TECHNICAL EDUCATION
(3-0) Cr. 3. SSI.
Prerequisite: 415.
Teaching processes, methods of presentation and testing, lesson planning, organization of instruction for trade preparation.
### Courses for Graduate Students, Major or Minor

<table>
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<th>Prerequisites</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>652</td>
<td><strong>Evaluation in Industrial Education</strong></td>
<td>(2 or 3-0) Cr. 2 or 3. F. Alt. SS. Offered 1968. Prerequisite: 15 credits in Ed. Carver.</td>
<td>Scoring of industrial education shops. Evaluating programs in industrial education. Developing testing programs; interpretation and utilization of test scores; teacher rating.</td>
</tr>
</tbody>
</table>
### Description of Courses

**656 ANALYSIS AND ORGANIZATION OF TEACHING MATERIALS.**
(3-0) Cr. 3. F. Alt. SSI. Offered 1968.
Prerequisite: 15 credits in Ed. Carver.
Techniques for identifying, collecting, analyzing, organizing and evaluating teaching materials for instructional purposes, methods and devices for effective use.

**657 CURRICULUM BUILDING IN INDUSTRIAL EDUCATION.**
(3-0) Cr. 3. F. Alt. SSI. Offered 1969.
Prerequisite: 15 credits in Ed. Carver.
Basic considerations in curriculum construction. Staff organization in curriculum building. Departmental articulation of subject matter. Articulation of industrial education course content with other school subjects. Continuous curriculum modification.

### ELECTRICAL ENGINEERING

Warren B. Boast, Ph.D., Head of Department


**Associate Professors:** Paul M. Anderson, Ph.D.; Dale W. Bowen, Ph.D.; Harrington C. Brearley, Jr., Ph.D.; Roger C. Camp, Ph.D.; Abdel-Aziz Fouad, Ph.D.; Morris H. Mericle, Ph.D.; Essam Nasser, Dr.-Ing.; Robert E. Post, Ph.D.; Allan G. Potter, Ph.D.; Robert A. Sharpe, M.S.; Charles L. Townsend, Ph.D.; C. James Triska, Ph.D.; Raymond A. Veline, B.S.


### Opportunities for 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.

### Opportunities for 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.

The department also offers major work for the degree Master of Engineering at approved off-campus locations. Such locations require approval by the Graduate Study Committee of library, laboratory and other facilities. A minimum of 12 credits for work taken in residence on Iowa State University campus is required. The language and thesis requirements may differ from those for the Master of Science degree. For further information, see Off-Campus Courses.
Electrical engineering is quite diverse, especially at the graduate level. Thus students can find considerable course offerings and research opportunities in biomedical engineering, circuit theory, computer technology, control and information systems, electric energy sources and conversion, electromagnetic wave propagation, electronic devices, electronic materials, and power systems engineering.

The normal prerequisite to major graduate work in electrical engineering is the completion of undergraduate work substantially equivalent to that required of engineering students at this university. Because of the diversification in the electrical engineering graduate program, however, it is possible for a student to qualify for graduate study in some of the areas enumerated above even though his undergraduate or prior graduate training has been in a discipline other than electrical engineering. Supporting work, if required, will depend on the student's background and his area of research interest. A prospective student from a discipline other than a curriculum in electrical engineering is urged to submit, with his application for admission, a statement of his proposed area of graduate study.

Courses normally will be offered as stated in the course description. Where no specific time of offering is stated, the course may be offered during any quarter provided there is sufficient demand.

Instruction in biomedical engineering is provided jointly by the Departments of Electrical Engineering, Veterinary Anatomy, and Veterinary Physiology and Pharmacology. Laboratory facilities are available in the Biomedical Engineering Building. See Biomedical Engineering for requirements for graduate minor.


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 AND MAGNETIC CIRCUITS.
   (3-0) Cr. 3. F.S.
   Prerequisite: Phys. 223, credit or classification in Math. 213.
   Basic concepts of electrical engineering Introduction to electric and magnetic circuits.

231. ELECTRICAL INSTRUMENTATION.
   (1-3) Cr. 2. F.S.
   Prerequisite: Credit or classification in 211.
   Principles of electrical instrumentation.

300. SEMINAR.
   (1-0) Cr. R.S.
   Prerequisite: Junior classification.

301, 302, 303. ELECTRIC CIRCUIT THEORY.
   301: (4-0) Cr. 4. W.S.S.; 302: (3-2) Cr. 4. F.S.; 303: (4-2) Cr. 5. F.W.
   Prerequisite: 301: 211, credit or classification in 231, credit or classification in Math. 321; 302: 301, credit or classification in Math. 322; 303: 302.
   Transient and steady state analysis of electric circuits using Laplace transform methods of analysis.

313. ELECTRIC AND MAGNETIC FIELD THEORY.
   (4-0) Cr. 4. S.S.S.
   Prerequisite: 303, Math. 410.
   Principles of quasi-static electric and magnetic fields. Introduction to time varying fields.

315. TELEVISION FUNDAMENTALS.
   (3-0) Cr. 3. F.W.
   Prerequisite: Sp. 301.
   Fundamentals of electricity and electronics. Radio and television broadcasting systems and equipment Television engineering standards Color television. Cannot be taken for credit by engineering students.

341, 342. D-C AND A-C 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.

374, 375,376. ELECTRONICS ENGINEERING.
   (3-3) Cr. 4 each. 374: F.W.; 375: W.S.; 376: S.S.S.
   Prerequisite: 374: 301; 375: 374; 376: 375.
   Characteristics of high vacuum, gaseous, and semiconductor electronic devices and solution of networks containing such devices.

377. ELECTROMECHANICAL DEVICES I.
   (3-1) Cr. 4. W.
   Prerequisite: Credit or classification in 302.
   Fundamentals of electromechanical energy conversion.

378. ELECTROMECHANICAL DEVICES II.
   (3-1) Cr. 4. S.
   Prerequisite: 377.
   Analysis of machine performance by the principles of electromechanical energy conversion.
410. INTRODUCTION TO SWITCHING CIRCUITS.
(C.S. 410) (3-0) Cr. 3. F.
Prerequisite: C.S. 214.
Truth tables; majority, threshold and multi-valued logic. Axiomatic development of two valued Boolean algebra; flow tables, stable and unstable states; excitation, transition and output matrices; pulse mode operations; clocked mode operations; simplification of completely and incompletely specified flow tables; asynchronous or self-timed logic.

411, 412. PRINCIPLES OF COMPUTER DESIGN.
(C.S. 411, 412) 411: (3-2) Cr. 4. 412: (3-0) Cr. 3. W.S.
Prerequisite: 411: 410; 412: 411.
11. Arithmetic circuits addition, subtraction, multiplication, restoring and non-restoring division, negative numbers, accuracy, speed, round-off. Control circuits instruction counters, decoders, timing circuits, order formats, conditional and unconditional transfers, instruction execution. 412. Memory circuits: memory organization, addressing protection, read only memories. Parallel computers, serial computers, character organized computers.

417. INTRODUCTION TO SYSTEMS ANALYSIS.
417: (3-0) Cr. 3. F. 418: (3-0) Cr. 3. W.
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. RECURRENT TRANSIENT AND DIGITAL CIRCUITS.
(3-3) Cr. 4. F.
Prerequisite: 376.
Design of pulse and digital circuits and response of systems to repeated transients.

428. ELECTRICAL PROPERTIES OF MATERIALS.
(4-0) Cr. 4. S.
Prerequisite: 376, Phys. 303.
Electrical properties of metals, semiconductors, insulators, and magnetic materials.

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 magneto-hydrodynamic generators (other energy conversion schemes).

441, 442. A-C AND D-C CIRCUITS.
(3-2) Cr. 4 each. 441: F.W.; 442: W.S.
Prerequisite: 441: Phys. 223; 442: 441.
Math. 321.
Principles of a-c and d-c circuit theory, transistors, transformers. Designed especially for aerospace, agricultural and mechanical engineers but available to others who satisfy the prerequisites.

445. 446. ELECTRONIC CIRCUITS, INSTRUMENTS, AND SYSTEMS.
445: (3-3) Cr. 4. W.S.; 446: (4-0) Cr. 4. S.
Prerequisite: 441 or 442: 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.

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 d-c machines, induction machines, synchronous machines and single phase machines.

452 ELECTRIC POWER MACHINERY.
(3-3) Cr. 4. S.
Prerequisite: 378 or 451.
Analysis of machine transients. Stability and control of multiphase and single phase machines.

465. 466. 467. POWER SYSTEM ENGINEERING.
465. 466: (4-0) 467: (3-3) Cr. 4 each. Yr.
Prerequisite: 465: 303, Credit or classification in 421. 465: 466: 467: 466.
Power system parameters, per unit calculations, modern solutions of power systems, symmetrical components, solution of faulted systems, power system stability, lightning surges.

471. BASIC BIOMEDICAL ELECTRONICS.
(3-0) Cr. 3. S.
Prerequisites: Math. 102; Phys. 113.
Practical introductory electronics including a-c 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).

498. SPECIAL PROBLEMS.
Cr. 1 to 6 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, 502. Analysis of linear systems by both operational and state-space methods. Introduction to modern concepts of stability, observability, and controllability in linear systems.
503. Response of linear systems to random inputs. Wiener filter theory.
511. SEMICONDUCTOR DEVICES. (3-0) Cr. 3. F.
Prerequisite: 375 or 446.
Basic concepts of semiconductor devices, design, analysis and application of transistor circuits.

518. 519, 520. ELECTRIC AND MAGNETIC PROPERTIES OF MATERIALS. (3-0) Cr. 3. J. Such F.W.S.
Prerequisite: 518: Phys. 303 or 423, 519: Phys. 513 or Met. 512; 520: 519

525 INTRODUCTION TO GASEOUS AND PLASMA ELECTRONICS. (3-0) Cr. 3.
Prerequisite: Phys. 303
Study of the various phenomena in ionized gases including ionization and excitation processes, mobility, diffusion and recombination and gaseous breakdown.

527. COMMUNICATION SYSTEMS ANALYSIS AND DESIGN. (3-3) 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.

541. ADVANCED SYMMETRICAL COMPONENTS. (3-0) Cr. 3. Alt. F. Offered 1968.
Prerequisite: 467.
Calculation of sequence impedances, analysis of unbalanced systems and unbalanced conditions.

542. POWER SYSTEM PROTECTION. (3-0) Cr. 3. Alt. W. Offered 1968
Prerequisite: 541.
Criteria for fault clearing, device coordination, relaying.

543. COMPUTER SOLUTIONS FOR POWER SYSTEMS. (3-0) Cr. 3. Alt. S. Offered 1969.
Prerequisite: 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. F. Offered 1967.
Prerequisite: 467.
Distribution components, design criteria, protective device coordination, secondary networks, voltage control.

545. POWER SYSTEM ANALYSIS. (3-0) Cr. 3. Alt. W. Offered 1967
Prerequisite: 467, 501, Math. 404.
Matrix analysis of large systems, linear vector space formulation, system models and equivalent circuits.

546. ECONOMIC OPERATION OF POWER SYSTEMS. (3-0) Cr. 3. Alt. S. Offered 1968.
Prerequisite: 545.
Operation of systems on a minimal cost basis, theory of incremental loading, system losses, methods of computation.

549. ELECTROMAGNETIC FIELDS. (3-0) Cr. 3. F.
Prerequisite: Math. 410, 511.
Static electric and magnetic fields, potential theory, fields in matter.

551. 552, 553. ELECTROMAGNETIC FIELDS. (3-0) Cr. 3 each. W.S.F.
Prerequisite: 551: 313 or 549; 552: 551; 553: 552.
551 Maxwell's equations, wave phenomena, guided wave 552 Plane, cylindrical and spherical wave functions. 553 Microwave networks, variational and perturbational techniques.

565. INFORMATION THEORY I. (3-0) Cr. 3. F.
Prerequisite: 418.
Information theory as applied to both discrete and continuous systems. Shannon's fundamental theorems. Introduction to coding theory.

566. INFORMATION THEORY II. (3-0) Cr. 3. W.
Prerequisite: 565.

567. INFORMATION THEORY III. (3-0) Cr. 3. S.
Prerequisite: 566.
Statistical decision theory and application to digital communication systems. Optimal detection of signals in noise. Parameter estimation.

571. THEORY AND TECHNIQUES OF BIOLOGICAL INSTRUMENTATION. (3-0) Cr. 3. W.
Prerequisite: V. Phys. 514, Math. 321.
Characteristics of biological signals, transducers, error and artifact suppression, biological data acquisition and processing systems.

572. SIMULATION OF BIOLOGICAL SYSTEMS. (3-0) Cr. 4. F.
Prerequisite: 446, V. Phys. 514.
Theory and operation of analog computers. Development of mathematical models for biological control systems and application of analog computers in the simulation of these systems.

575. CONTROL SYSTEM SYNTHESIS. (3-0) Cr. 4. S.
Prerequisite: 418.
System specifications; time and frequency domain techniques for synthesizing closed loop systems.

576. SAMPLED-DATA SYSTEMS. (3-0) Cr. 3.
Prerequisite: 502, 575.
Z-transform and Z-form methods applied to sampled-data systems.
584. HIGH SPEED COMPUTER DESIGN.  
(C.S. 584) (3-0) Cr. 3. F. 
Prerequisite: 412. 
High speed arithmetic, carry speed up and carry storage; redundant number representation; re-coded multipliers; restoring and non-restoring division, multiple precision; overflow detection and treatment; floating point arithmetic. High speed control, look ahead controls, memory interleaving and interlocks.

585. ADVANCED COMPUTER ORGANIZATION.  
(C.S. 585) (3-0) Cr. 3. W. 
Prerequisite: 584. 
Time sharing, multi-processor computers, interrupts and priorities, memory hierarchies, scratch pad memories, memory protection, channel organization.

586. THEORY OF COMPUTER ORGANIZATION.  
(C.S. 586) (3-0) Cr. 3. S. 
Prerequisite: 585. 
Theoretical description of computer organization using Iversen notation.

589. COMPUTER DEVICES.  
(3-0) Cr. 3. 
Prerequisite: 426, 511, 520. 
Optimization of material properties to be used in computer subsystems.

595. SPECIAL TOPICS. 
Cr. 2 to 5 each time elected. F.W.S. 
Formulation and solution of theoretical or practical problems in electrical engineering.

COURSES FOR GRADUATE STUDENTS, major or minor

611, 612, 613. SYNTHESIS OF PASSIVE NETWORKS.  
(3-0) Cr. 3 each. F.W.S. 
Prerequisite: 502. 
Synthesis of passive electric networks.

618, 619. ADVANCED TOPICS IN ELECTRICAL MATERIALS.  
(3-0) Cr. 3 each time elected. 
Prerequisite: 526. 
A Superconductivity 
B Stimulated emission amplification 
C Coupled wave phenomena

621. ADVANCED TOPICS IN ELECTROMAGNETIC THEORY.  
(3-0) Cr. 3 each time elected. 
Prerequisite: 553. 
A Propagation in periodic structures and anisotropic media 
B Propagation in turbulent media 
C Radiowave propagation around the earth 
D Coupled mode theory

641. HIGH VOLTAGE ENGINEERING.  
(3-0) Cr. 3. Alt. F. Offered 1968. 
Prerequisite: 467, 525. 
Transmission at high voltages, corona, in solution coordination, radio interference.

642. HIGH VOLTAGE TRANSIENTS.  
(3-0) Cr. 3. Alt. W. Offered 1968. 
Prerequisite: 542, 641. 
Analysis of traveling waves on high voltage circuits, restrike in circuit breakers, switching surges, lightning phenomena.

643. D. C. TRANSMISSION.  
(3-0) Cr. 3. Alt. S. Offered 1969. 
Prerequisite: 642. 
Transmission by direct current, inverter design, system simulation, parallel operation, stability considerations.

644. POWER SYSTEM STABILITY.  
(3-0) Cr. 3. Alt. F. Offered 1967. 
Prerequisite: 542. 
Transient and steady-state stability problems, classical and modern analysis techniques, swinging out-of-step.

645. INTERCONNECTED POWER SYSTEM CONTROL.  
(3-0) Cr. 3. Alt. W. Offered 1967. 
Prerequisite: 467, 502, 644. 
Analysis of control objectives, control device theory and application, communication of control information, transient response considerations.

646. INTERCONNECTED POWER SYSTEM STABILITY.  
(3-0) Cr. 3. Alt. S. Offered 1968. 
Prerequisite: 645. 
Modern methods of stability analysis applied to interconnected power systems.

650. ADVANCED LABORATORY.  
Cr. 1 to 3 each time elected. 
Selected projects in areas of advanced electrical engineering.

661. COMPUTER SEMINAR.  
Cr. 1-3 each time elected. 
Prerequisite: 586. 
Various computer topics of timely interest.

665. ADVANCED TOPICS IN ELECTRIC MACHINERY.  
(3-0) Cr. 3 each time elected. 
Prerequisite: 502. 
Advanced topics in connection with machine transients, synchronous and induction machines, transformers and special machines.

671. BIOMEDICAL INFORMATION PROCESSING.  
(3-0) Cr. 3. S. 
Prerequisite: 446. 
Biological signal processing including the application of computers and advanced servomechanism concepts to biological systems. Medical automation, bionics, including neuron models and recognition systems.

675. ADVANCED TOPICS IN RANDOM PROCESS THEORY.  
(3-0) Cr. 3. 
Prerequisite: 503. 
Recursive filtering techniques of Kalman. Other topics of current interest in stochastic-process theory.

676. OPTIMAL CONTROL THEORY.  
(3-0) Cr. 3. 
Prerequisite: 503. 
Variational approach to optimal control Dynamic programming Pontriagin's maximum principle.

677. NONLINEAR SYSTEMS.  
(3-0) Cr. 3. 
Prerequisite: 502. 
Techniques of analysis and synthesis of nonlinear control systems Lyapunov's second method.
684. ADVANCED SWITCHING THEORY. (C.S. 684) (3-0) Cr. 3.
Prerequisite: 410 and permission of instructor.
Sequential logic with emphasis on the formalisms.

685. ADVANCED LOGIC SYSTEMS. (C.S. 685) (3-0) Cr. 3.
Prerequisite: 684.
Pattern recognition processors, adaptive processors, distributed processors.

686. AUTOMATA THEORY. (C.S. 686) (3-0) Cr. 3.
Prerequisite: 684.
Turing machines, finite state machines, computability.

690. RESEARCH.
F.W.S. Graduate staff.

ENGINEERING
George R. Town, D. Engr., Dean of Engineering
Paul E. Morgan, M.S., Assistant Dean

Professors: Eugene S. Ferguson, M.S.; Lawrence R. Hillyard, M.S.
Associate Professors: Milton L. Rogness, M.S.; Raymond A. Vellne, B.S.

Opportunities for Undergraduate Study
For undergraduate curricula offered in the several departments of engineering leading to the degree Bachelor of Science, see College of Engineering, Curricula.
The orientation courses listed are required of all freshman engineering students in order to provide information that will help the student in his work in the College of Engineering and will also help him in deciding which curriculum he will follow after the first year.

COURSES PRIMARILY FOR UNDERGRADUATE STUDENTS

114, 115. ORIENTATION.
(1-0) Cr. R.
114: Nature of professional work in engineering. Methods of testing individual's aptitudes for engineering profession. 115 Nature of various branches of engineering and some fundamental considerations in selecting a career.

190. SPECIAL TOPICS.
Cr. 1 to 5 each time 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 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.

421, 422. HISTORY OF ENGINEERING.
(Hist. 421, 422) (3-0) Cr. 3. 421: F.W.; 422: W.S.
Prerequisite: Junior classification.
422. 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.

515. HISTORY OF TECHNOLOGY IN U.S.
(Hist. 515) (3-0) Cr. 3. S.
Prerequisite: 422.
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.
(Hist. 561) (3-0) Cr. 3. F.
Prerequisite: 422.
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.
(Hist. 590) Cr. 2 to 5.
Prerequisite: 9 credits in history of technology.
Opportunities for Undergraduate Study

Adequate training in the graphical language brings the engineer a professional literacy essential and preliminary to all engineering work. Greater emphasis is being placed upon the graphical solution of problems involving space relationship as well as an increased recognition of the speed and accuracy of graphical methods to replace and supplement mathematical solutions of engineering problems.

In teaching the fundamentals of engineering graphics, attention is directed not alone to the technique of drawing but more upon the power to visualize. This power is developed both for reading and writing the language. The several phases of this graphical language are integrated in such a way as to produce a logical whole. Freehand sketches are employed extensively, using orthographic and pictorial methods to teach rapid execution of shape-description problems, while complete working drawings are made to conform with accepted drafting standards in the several fields of engineering.

Engineering graphics in itself is not a profession. Nevertheless, proficiency in its use is the gateway through which many enter the field of engineering.

COURSES PRIMARILY FOR UNDERGRADUATE STUDENTS

121 DRAWING AND PERSPECTIVE
(1-6) Cr. 3. S
Sketching and lettering, use of drawing instruments and materials. Single and multiview projection, space problems in pictorial or multiview projection of points, lines, planes and solids. Freehand and instrumental drawing involving sections, conventional practices, and basic size specifications.

131. DRAWING AND PROJECTION.
(0-6) Cr. 2. F.W.S.
Freehand sketching and lettering, use of drawing instruments, triangles, architect's and engineer's scales. Elementary space problems in pictorial or multiview projection of points, lines, planes and solids. Freehand and instrumental drawing involving sections, conventional practices, and basic size specifications.

132. GRAPHICAL THEORY AND APPLICATION
(1-6) Cr. 3. W.S.
Prerequisite: 131.
Continuation of 131 to provide instruction in freehand and instrumental drawing. Axonometric, oblique and perspective drawing. Determination of true distance, clearances, true angles, true sizes and shapes. Plane, single curved, double curved, and warped surfaces. Surface developments and intersections.

133. WORKING DRAWINGS AND APPLIED GRAPHICS.
(1-6) Cr. 3. W.S
Prerequisite: 132.
Comprehensive treatment of dimensioning and conventional representation as applied to all fields of engineering. Details, layouts, assemblies. Specification standards. Introduction to graphical solutions. Coordinate systems, curve plotting, mathematical equations, alignment charts, vector geometry, and graphical calculus.

141. ARCHITECTURAL GRAPHICS I.
(0-6) Cr. 2. F.

142. ARCHITECTURAL GRAPHICS II.
(0-6) Cr. 2. W.
Prerequisite: 141.
Spatial geometry. Involving angles, piercing points and clearances. Plane and space vector geometry, delineation, intersection, and development of plane, single curved, double curved, and warped surfaces.
143. ARCHITECTURAL GRAPHICS III.
(0-6) Cr. 2. S.
Prerequisite: 142.
Perspective drawing, shades and shadows in perspective and orthographic, reflections
Principles of presentation drawings

235. ADVANCED GRAPHICAL PROBLEMS
(0-3 to 15) Cr. 1 to 5. S.
Prerequisite: 133, permission of department head.

Advanced graphical theory and application in the several fields of engineering. Choices include patent drawings; advanced detailing; layout and assembly drawing; gears, cams, linkages. Map projections, contours, ratio charts. Production illustration. Advanced work in graphical differentiation, graphical integration, graphical derivation of empirical equations, alignment charts and nomographs

ENGINEERING JOURNALISM

Administered by the Department of Industrial Engineering in cooperation with the Department of Technical Journalism.

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 new 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 Technical 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:

101. Introduction to Mass Communication .................................. 2 credits
Group A - 2 but no more than 4 courses ............................... minimum 7-8 credits
(221, 222, 252, 325, 341)
Group B - 2 but no more than 4 courses ............................... minimum 6-7 credits
Group C - at least 3 courses .................................................. 9 credits
(417, 430, 431, 462, 463, 464)
Additional .............................................................................. 6-8 credits

E. Gr. 143 may be substituted for E. Gr. 133; a Group C journalism course, preferably 430, for I. Ad. 365A; and a Group B journalism course, preferably 223, for Engl. 414A. Two courses selected from 431, 462, and 464 may be taken as socio-humanistic electives, and four group A and B courses as management-business electives.

A minimum of 32 journalism credits is required in the program. The minimum credit hours required for graduation in the engineering journalism program is 188.

ENGINEERING MECHANICS

Harry J. Weiss, D.Sc., Head of Department


Associate Professors: Kenneth G. McConnell, Ph.D.; Gundo A. Nariboli, Ph.D.; Aldor C. Peterson, M.S.; William F. Riley, M.S.

Assistant Professors: Frank H. Brittain, Ph.D.; Frederick M. Graham, Ph.D.; Shun-Ku Lee, Ph.D.; Michael A. McCoy, M.S.; Jack S. Petersen, M.S.; Thomas R. Rogge, Ph.D.; Donald P. Smith, M.S.; Chang-Tsan Sun, Ph.D.

Instructors: Jimmy G. Wallace, M.S.
Opportunities for 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.

Opportunities for Graduate Study

The department offers major work for the degrees Master of Science and Doctor of Philosophy in engineering mechanics, and minor work to students taking major work in other departments.

Prerequisite to major graduate work is the satisfactory completion of a curriculum substantially equivalent to that required of undergraduate students in engineering at this institution. This should include the undergraduate courses necessary for the particular field chosen.

Courses open to graduate students for minor graduate credit only: 324, 327, 337, 344, 354, 378, 420, 444, 490.

COURSES PRIMARILY FOR UNDERGRADUATE STUDENTS

274. STATICS OF ENGINEERING.
(1 0) Cr. 1 F.W.S SSI.SSI.
Prerequisite: Math. 112. Phys. 221.
Vector and scalar treatment of coplanar and noncoplanar force systems. Resultants, equilibrium, friction, centroids, moment of inertia, product of inertia, principal moment of inertia, virtual work

324 MECHANICS OF MATERIALS
(5 0) Cr. 5 F.W.S.SSI.SSI.
Prerequisite: 274
Plane stress, principal stress, two-dimension strain. Elements of stress and deformation analysis applied to members subjected to centripetal, torsional, flexural, and combined loading, statically determinant and indeterminate systems. Elementary stability, applications to columns. Static, dynamic, repeated loading

327. MATERIALS LABORATORY
(0-3) Cr. 1 F.W.S.SSI.
Prerequisite: Credit or classification in 324. 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 321 and 331.
Similar to 327 with additional topics and added emphasis on concrete. One day in section trip

311. DYNAMICS OF ENGINEERING
(1 0) Cr. 1 F.W.S.SSI. SSI.
Prerequisite: 271.
Vector and scalar treatment of kinematics, coplanar motion of particles and rigid

bodies. Kinetics; vector and scalar treatment of force-mass-acceleration and impulse-momentum-methods; constant and variable mass, coplanar and noncoplanar systems; work-energy method

351 ENGINEERING MATERIALS.
(3 0) Cr. 3. F.W.S.
Prerequisite: Credit or classification in 324. Properties, uses, and manufacture of metals, timber, stone, clay products, cement, concrete and other engineering materials

378 MECHANICS OF FLUIDS.
(3 2) Cr. 1 . F.W.S.SSI
Prerequisite: 311.
Properties of fluids Fluid statics. Kinematics and kinetics of one-dimensional flow. Impulse momentum, dimensional analysis, flow in pipes and channels. Engineering applications. Selected laboratory experiments

420 PRINCIPLES OF MECHANICS IN BIOMEDICAL ENGINEERING.
(1-0) Cr. 1. 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.
(3-2) Cr. 4. W.
Prerequisite: 344.
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. Staff.
* A student who is not present for the first labora-

tory 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.

511. ADVANCED MECHANICS OF
MATERIALS.
(3 or 4-0) Cr. 3 or 4. F.
Prerequisite: 324.
Special problems met in engineering Limita-
tions of flexure and torsion formulas, un-
symmetrical bending, curved beams, com-
combined stresses, theories of failure, thin

tubes, thick hollow cylinders, photoelasticity.

515. DEVELOPMENT OF MECHANICS.
(2 to 4-0) Cr. 2 to 4. W.
Prerequisite: 321, 344.
Historical development of the expression

of the principles of mechanics.

517. EXPERIMENTAL STRESS ANALYSIS.
(3-2) Cr. 4. W.
Prerequisite: 324.
Fundamental concepts of strain measure-
ment, properties of Stresscoat and its
application, wire, foil and semi-conduc-
	or strain gages, strain gage circuits and re-
cording instruments, rosette analysis, ana-
logies, introduction to photoelasticity and
more methods.

518. PHOTOELASTICITY AND MORE
METHODS.
(3-2) Cr. 1. S.
Prerequisite: 321.
Two and three-dimensional photoelasticity,
compensation techniques, principal stress
separation using shear difference, oblique
incident and other methods, birefringent
coatings, scattered light, design of models,
more methods and their application.

530 INTRODUCTION TO MECHANICS OF
CONTINUOUS MEDIA.
(Math. 530) (3-0) Cr. 3. F.
Prerequisite: Math 110.
Cartesian tensors, stress, strain and strain
rate tensors, field equations, simple con-
stitutive equations, perfect and viscous
fluids, linear elasticity, simple anelastic
materials.

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: viscous and other simple
flows.

544. MECHANICAL VIBRATIONS.
(3-2) Cr. 4. F.
Prerequisite: 344, 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 com-
puters in analysis of vibration problems.

545. ADVANCED VIBRATION ANALYSIS.
(3-0) Cr. 3. W.
Prerequisite: 544.
Impulsive and arbitrary excitation of linear
systems, primary and residual shock spe-
\nra. Non-linear vibrations, phase plane and
approximate solutions. Multiple degrees of
freedom, inertia and stiffness matrices, nu-
merical methods. Continuous systems, vib-
\rating string and rod, Euler beam, rotary
inertia and shear deformation. Digital com-
puting techniques.

548, 549. ADVANCED ENGINEERING
DYNAMICS.
548: (1-0) Cr. 4. F.; 549: (3-0) Cr. 3. W.
Prerequisite: 344, Math. 321.
Dynamics of particles and rigid bodies ap-
plied to advanced engineering problems.
Generalized coordinates: Hamilton’s Prin-
\ principle and Lagrangian equations of motion.
Orbital motion, stability of oscillatory
motion, non-linear systems.

555. LINEAR WAVE PROPAGATION.
(3-0) Cr. 3. Alt. W.
Prerequisite: 530.
Surfaces of discontinuity, wave fronts and
characteristics, one-dimensional wave equa-
tion, reflection and refraction of acoustic
waves, irrotational and equiluminal
elastic waves. Anisotropic, layered media,
Rayleigh waves.

564 ELASTIC STABILITY.
(3-0) Cr. 3. F.
Prerequisite: 514 or 530, credit or classifica-
tion in Math. 322.
Stability of columns, beam-columns, and
panels. Assumptions and limitations
Lateral buckling of beams. Torsion of thin
walled members.

568 APPLIED PLASTICITY.
(3-0) Cr. 3. W.
Prerequisite: 514 or 530.
The plastic state of engineering materials,
types of flow, creep and relaxation, redis-
tribution of strain and stress. Engineering
applications.

569. INTRODUCTION TO LINEAR
VISCOELASTICITY.
(3-0) Cr. 3. S.
Prerequisite: 530.
Definition of linear viscoelastic material;
simple mechanical models, generalized
models, differential and integral constitutive
laws. Boundary value problems, transform
methods, correspondence principle, varia-
tional 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.Eng. 424, Math.
410; 572, 573: 571 or 530.
571 Fundamental relationships of fluid

dynamics; real and ideal fluids; laminar
and turbulent flow, flow in closed conduits
and open channels; boundary layer theory;
opportunities for undergraduate courses of science, see assistant professors:

the core of the program, which is wish to receive comprehensive training in the fundamental principles and concepts of engineering rather than to specialize in one particular field. the curriculum in engineering science is designed particularly for those students who

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

overview of courses

description of courses

for graduate students, major or minor

rf research.

seminar.

rheology ii.

rheology.

advanced topics in rheology.

fluid mechanics seminar.

fluid mechanics seminar.

advanced theoretical aspects of compressible flow and turbulence.

engineering science

opportunity for 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 an extensive background in chemistry, mathematics and physics, consists in the engineering sciences 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.

Opportunities for 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.

351. ENGINEERING MATERIALS.
(3-2) Cr. 4. F.
Prerequisite: Credit or classification in E.M. 324.
Resistence of materials to failure, definitions and evaluation of properties, relationship to design. Effects of environment on properties. Laboratory determinations

352 ENGINEERING MATERIALS.
(3-2) Cr. 4. W.
Prerequisite: 351 or E.M. 354.
Structure of materials, and influence of structure upon properties. Properties of single crystals. Interatomic forces, energy considerations

353. ENGINEERING MATERIALS.
(3-2) Cr. 4. S.
Prerequisite: 352
Thermal and electrical characteristics, poly crystalline systems, aggregates of domains. Engineering applications

101, 402, 403 SEMINAR.
(1-0) Cr. R.F.W.S.
Prerequisite: Senior classification.

181. 482, 483. ENGINEERING ANALYSIS.
(3-2) Cr. 4 each. F.W.S.
Prerequisite: Chem.E. 461, E.M. 324, 344, Math. 410.
Application of the engineering sciences to the analysis of components and systems

484. PRINCIPLES OF SIMILITUDE.
(3-2) Cr. 4. F.
Prerequisite: E.M. 324.
Dimensional analysis. Principles governing the design and operation of models for the solution of engineering problems. Analogies.

491. ENGINEERING DESIGN.
(1-6) Cr. 4. S.
Prerequisite: Credit or classification in 483.
Design problems in engineering science

499. SPECIAL PROBLEMS.
Cr. 2 to 5. F.W.S.
Prerequisite: Permission of department head.
Investigation of an approved problem commensurate with the training, interest and ability of the student

ENGLISH AND SPEECH

Albert L. Walker, Ph.D., Chairman of Department

Professors: Frank H. Brandt, M.S.; David K. Bruner, Ph.D.; Leonard Feinberg, Ph.D.;
Richard L. Herrnstadt, Ph.D.; Pearl Hogrefe, Ph.D.; Keith G. Huntress, Ph.D.; W. Paul
Jones, Ph.D.; Will C. Jumper, Ph.D.; C. Buell Lipa, Ph.D.; Fred W. Lorch, Ph.D.; James
A. Lowrie, Ph.D.; R. Dale McCoy, Ph.D.; E. Duncan Mallam, Ph.D.; Robert B. Orlovich,
Ph.D.; Raymond C. Palmer, Ph.D.; Fredrica Shattuck, B.A.; W. R. Underhill, Ph.D.; George
P. Wilson, Jr., Ph.D.; Norris W. Yates, Ph.D.

Associate Professors: Donald R. Benson, Ph.D.; Phillips G. Davies, Ph.D.; M. Burton Drexler,
Ph.D.; Elizabeth Fuller, A.M.; Richard C. Gustafson, Ph.D.; James E. Humphrey,
M.A.; Hazel E. Lipa, M.A.; John F. Speer, Ph.D.; Richard J. Weinman, Ph.D.

Assistant Professors: Edward M. Bodaken, M.A.; Rosemary Davies, M.A.; Sherry Hoopes,
Rachel M. Lowrie, M.A.; Leonard R. Mendelsohn, Ph.D.; Fred J. Vallier, M.A.; Richard
J. Zbaracki, M.A.

Instructors: Wayne E. Almquist, B.A.; Sharon C. Anderson, B.S.; Mary Jane Andrews,
M.S.; Betty S. Azar, B.A.; Carole A. Bernard, B.A.; Catherine B. Curran, M.A.; Ray
D. Dearin, M.A.; Donald W. Dunlop, A.B.; Cyril J. Eckelberg, M.A.; Carolyn G. Errington,
Opportunities for 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 Teacher Certification. Second, students can prepare for graduate study and eventual teaching in college or university. Third, students can prepare for positions in business and industry: technical writing, advertising, sales and public relations, personnel, radio and television. Students also can 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. 101, 102 and 103 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 all 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, 334, 336, 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.

Opportunities for Graduate Study

The department offers major work for the degree Master of Science in English and minor work for students majoring in other departments.

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 each of the following:
1. Further graduate studies in language and literature.
2. Teaching at the secondary, junior college, or beginning university level.
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 in English

COURSES PRIMARILY FOR UNDERGRADUATE STUDENTS

10A, 10B, 10C. ENGLISH FOR FOREIGN STUDENTS.
(4-2) Cr. 0. 10A: F.W.S.; 10B: F.W.; 10C: F.S.
Prerequisite: 10B: 10A or permission of instructor.
10A Grammar, both oral and written. 10B: Composition and reading comprehension. 10C: English pattern practices and pronunciation. 10A and 10B may be taken concurrently. A two-hour laboratory is required with 10A and 10B.

15. REMEDIAL SPEECH.
(0-2) Cr. 0. F.W.S.
Prerequisite: Permission of instructor.
Analysis of the student's speech handicaps followed by intensive training or therapy in the speech clinic.

101, 102, 103. PRINCIPLES OF COMPOSITION
(3-0) Cr. 3 each. 101: F.W.S.SSI, SSII; 102: F.W.S.SSI; 103: F.W.S.SSI.
Prerequisite: 102: 101; 103: 102.
Application of principles governing the use of language in writing and reading. 101: Adaptation of expression to specific and descriptive techniques; introduction to expository writing. 102: Techniques of informative and persuasive writing; expository readings. 103: Selection of techniques for communicating fact, opinion, and feeling; function of literature as a source of ideas and values.

131, 132. PRINCIPLES OF COMPOSITION.
(3-0) 131: Cr. 5; 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. An accelerated course designed for especially advanced students as an alternate to 101, 102, 103. Satisfies 101-2-3 requirement in all curricula.

200. DEVELOPMENTAL READING.
(0-2) Cr. 1 each time elected, maximum 3 Crs.
F.W.S.SSI, SSII.
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.SSI, SSII.
Prerequisite: 103.
Introduction to the functions of the arts, particularly literary. 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: 103.
Expository writing: practice in writing and criticizing exposition. Concepts of grammar and rhetoric where pertinent to analysis of writing

205. PROPAGANDA ANALYSIS:
(3-0) Cr. 3. F.W.S.SSI.
Prerequisite: 103.
Study of the language in which current issues are presented to the public, especially language which may arouse feeling or confuse thought. Application of basic rules of thinking to issues studied; practice in informative and persuasive writing; reading and discussion

304A, 304B. ADVANCED COMPOSITION.
(3-0) Cr. 3. F.W.S.
Prerequisite: 103 or 132, junior or senior classification, permission of instructor.
304A Descriptive and narrative techniques; emphasis on characterization and the short story. Writing, reading, criticism. 304B Personalized exposition; personal, social, or scientific material with individualized expression

306A, 306B. ADVANCED COMPOSITION.
Cr. 3 each time elected. F.W.S.
Prerequisite: 304A or 304B, permission of instructor.
306A Individual projects stories, novels, poems. 306B Individual projects, essays, biography, autobiography

315. SCRIPT WRITING FOR TELEVISION, FILM, AND RADIO.
(3-0) Cr. 3. W.
Prerequisite: 304, Sp. 302, permission of instructor.
Techniques of writing for television, film, and radio. Selected scripts used in broadcasts on WO1.

330. MODERN LITERATURE.
(3-0) Cr. 3. W.S.SSI.
Prerequisite: 201.
Introduction to modern literature through the reading, interpretation and evaluation of prose, fiction, drama and poetry of representative American and British authors of the twentieth century.

344. READINGS IN BIOGRAPHY.
(3-0) Cr. 3. S.
Prerequisite: 201.
Selections from biography and autobiography of great creative workers in science, engineering, agriculture, the arts, government. Other eminent contributors to civilization. Special attention to lives of scientists
and to procedures of science. Impact of great men upon their own and later times.

354A, 354B. WORLD LITERATURE.
(3-0) Cr. 3 each. 354A: W.S.SSI; 354B: S.SSI.
Prerequisite: 201.
354A Ancient classics to Renaissance. Greek and Roman literature; European literature of the middle ages; selections from Indian, Chinese, Arabian, and Persian literature. 
354B European literature, Renaissance to 1900 Selected European literature from early Renaissance to modern times.

356. OLD TESTAMENT.
(3-0) Cr. 3. S.
Prerequisite: 201.
Literature of Old Testament and apocrypha including narrative, poetry, wisdom literature, and apocalyptic literature.

363A, 363B. AMERICAN LITERATURE TO 1850.
(3-0) Cr. 3 each. 363A: F.W.S.SSI; 363B: Alt. S. Offered 1968.
Prerequisite: 363A: 201. 363B: 363A or equivalent.
363A: Selected American masterpieces to 1850, their literary value and their significance as expressions of varying attitudes toward the individual and society. 363B: Literature of Colonial America. Significant American literary figures from 1600 to 1800.

(3-0) Cr. 3 each. 364A: F.W.S.SSI; 364B: Alt. F. Offered 1968.
Prerequisite: 364A: 201. 364B: 364A or equivalent.
364A: Selected American masterpieces, 1850-1900, with attention to their literary value and their significance as expressions of varying attitudes toward the individual and society. 364B: Realism in American literature. Significant writers and works in the rise of American realism between the Civil War and World War I.

366. WORLD DRAMA: THE GREEKS TO IBSEN.
(3-0) Cr. 3. W.
Prerequisite: 201.
The development of drama from classical times through the nineteenth century.

367. WORLD DRAMA: IBSEN TO THE PRESENT.
(3-0) Cr. 3. S.
Prerequisite: 201.
The development of twentieth century drama.

368. BRITISH DRAMA TO 1642.
EXCLUSIVE OF SHAKESPEARE.
(3-0) Cr. 3. Alt. W. Offered 1968.
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 1969.
Prerequisite: 374A: 201. 374B: 374A or equivalent.
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.SSI; 375B: Alt. W. Offered 1968.
Prerequisite: 375A: 201. 375B: 375A or equivalent.
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 1967.
Prerequisite: 376A: 201. 376B: 376A or equivalent.
376A: Selected British authors, 1800-1900. Introduction to English literature of the Romantic and Victorian periods. 376B: The Romantic Movement, Blake, Burns, and minor pre-Romantics; Wordsworth, Coleridge, Scott, Byron, Shelley, Keats, Lamb, Hazlitt, DeQuincey.

384A, 384B. MODERN FICTION.
(3-0) Cr. 3 each. 384A: F.S.SSI; 384B: S.
Prerequisite: 201. 384A: 384B.

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.
(3-0) Cr. 3 each. 392A: Alt. W. Offered 1969, 392B: Alt. S. Offered 1969.
Prerequisite: 201.
392A: Development of the English novel to 1832. 392B: The Victorian novel.

404. BUSINESS CORRESPONDENCE.
(2-0) Cr. 2. W.S.
Prerequisite: 103, junior classification. Principles which govern the writing of business letters. Types of business letters.

414A, 414B. WRITING OF REPORTS AND TECHNICAL PAPERS.
(3-0) Cr. 3 each. F.W.S.SSI.SSI.
Prerequisite: 414A: 103, junior or senior classification; 414B: Permission of instructor.
414A: Technical, research, and business report writing. Principles of engineering and technical exposition; problems in engineering and technical reports and in research papers of various kinds. 414B: Advanced expository writing. Emphasis on putting research material into report form; individual projects.

419. MODERN GRAMMAR.
(3-0) Cr. 3. W.
Prerequisite: 103.
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 Engl. beyond 103 or the equivalent in 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, 464B. SHAKESPEARE.
(3-0) Cr. 3 each. 464A: F.S.; 464B: W.
Prerequisite: 464A: 201; 464B: 464A.
464A. Introduction to Shakespeare's dramatic art. Selected comedies, histories, and tragedies, with emphasis on the understanding of character. 464B: Shakespeare's development as a dramatist. Intensive study of selected plays, with emphasis on Shakespeare's development as a playwright; background of the period; introduction to Shakespearean scholarship.

476. VICTORIAN POETRY.
(3-0) Cr. 3. Alt. F. Offered 1967.
Prerequisite: 376A.
Selected Victorian poets with attention to later and transitional figures. Aspects of the Victorian age reflected in the poetry.

COURSES PRIMARILY FOR GRADUATE STUDENTS, major or minor, open to qualified undergraduates

503. PROBLEMS IN WRITTEN COMMUNICATION.
(3-0) Cr. 3. W. SSI.
Prerequisite: Permission of instructor.

504. ADVANCED IMAGINATIVE WRITING.
(3-0) Cr. 3. S.SSII.
Prerequisite: 304A or B or equivalent and permission of instructor.
Individual projects.

507. SCIENTIFIC AND TECHNICAL WRITING.
Cr. 3 to 6. S.SSII.
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. On-the-job writing in industry as arranged when proper basis is established.

511, 512. HISTORY AND STRUCTURE OF THE ENGLISH LANGUAGE.
(3-0) Cr. 3 each. W.3. SSI, SSI.
Prerequisite: Permission of instructor.
Development of the language from early to modern times. Introduction to linguistic method. Selected topics in linguistics with emphasis on modern uses and applications.

530. BIBLIOGRAPHY AND RESEARCH METHODS.
(3-0) Cr. 3. F.SSI.
Prerequisite: 18 credits in literature. Required of candidates for the master's degree.

534. LITERATURE AND SCIENCE.
(3-0) Cr. 3. S.
Prerequisite: 375A and Hist. 411 or 510.
Second and eighteenth and nineteenth 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. Alt. S. Offered 1968.
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. F. Offered 1969.
Prerequisite: 9 credits in American literature including 364A.
Major developments in the American novel to 1900.

564. SIGNIFICANT AMERICAN NONFICTION.
(3-0) Cr. 3. S.
Prerequisite: 9 credits in American literature including 364A.
Idealism, realism, and skepticism since the 1840's, as reflected by essayists of distinction: Emerson, Thoreau, Twain, William James, Henry Adams, Veblen, Santayana, Bourne, Mencken, E. B. White, and others.

566. MAJOR AMERICAN POETS.
(3-0) Cr. 3. W.
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.
Courses in Speech and Telecommunicative Arts

COURSES PRIMARILY FOR UNDERGRADUATE STUDENTS

120. INTRODUCTION TO THEATRE. (3-0) Cr. 3. F.W.S.
Prerequisite: Engl. 101 or 131.
Development of the performing arts from antiquity to the present.

125. FUNDAMENTALS OF ACTING. (3-0) Cr. 3. F.W.S.
Prerequisite: Theor et practice in acting; experience in creating characterizations.

206A, 206B, 206C. TELEVISION WORKSHOP.
(0-4) Cr. 2 each. F.W.S.SSI, SSII.
Prerequisite: 206B: 206A; 206C: 206B.
206A: Introduction. Theory and function of studio facilities; duties of television production team; drill and practice in various duties. 206B: On-the-air experience in educational television production and direction via closed circuit or floor work and talent in WOI-TV programs. 206C: Continuation of 206B.

207. VOICE AND DICTION. (3-0) Cr. 3. F.W.S.SSI.
Prerequisite: Theor et practice in acting; experience in creating characterizations.

211. FUNDAMENTALS OF SPEECH. (3-0) Cr. 3. F.W.S.SSI, SSII.
Prerequisite: Engl. 103.
Theory and practice of effective television and radio speaking under closed circuit conditions.

228. DEVELOPMENT OF THE MOTION PICTURE. (2-2) Cr. 3. Alt. W. Offered 1968.
Prerequisite: Engl. 103 or 132.
Development of the motion picture from prephotographic eras to the present; individuals responsible for major advances in theory and technique.

301. SURVEY OF RADIO AND TELEVISION BROADCASTING. (3-0) Cr. 3. W.
Prerequisite: Engl. 103.
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.S.
Prerequisite: Engl. 103.
Theory and practice of effective television and radio speaking under closed circuit conditions.
305. GENERAL SEMANTICS.  
(3-0) Cr. 3. F.W.SSI.  
Prerequisite: Engl. 103.  
Nature of symbolic processes; influence of verbal habits in human affairs; relationships between language and personal or social problems; accuracy and precision in the use of verbal symbols.

309. ORAL INTERPRETATION.  
(3-0) Cr. 3. F.S.  
Principles of oral interpretation, practice in analysis and reading aloud of literary selections.

312. BUSINESS AND PROFESSIONAL SPEAKING.  
(3-0) Cr. 3. F.W.S.SSI.  
Prerequisite: 328A. Two quarters of business.  
Methods of application of fundamental principles of public speaking to composition and delivery of common types of business and professional speaking, practice in preparation and delivery of various types of speeches.

320. DRAMATICS.  
Cr. 1 to 3 each time elected, with a maximum of 6 credits. F.W.S.  
Prerequisite: Engl. 103, permission of instructor.  
Rehearsal and production of plays.

321. RADIO WORKSHOP.  
Cr. 1 to 3 each time elected, with maximum of 6 credits. F.W.S.  
Prerequisite: Engl. 103, 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. 324B: W. 324C: S.  
Prerequisite: Engl. 103.  
324A: Principles of play production; choosing the play, casting, rehearsing, staging, and lighting 324B: Costuming and make-up, techniques of make-up for theatre and television; 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. W.S.  
Prerequisite: Engl. 103.  
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, 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, 236, 328B: 328A.  

331A. 331B. PERSUASION.  
(3-0) Cr. 3 each. 331A: F.W.; 331B: S.  
Prerequisite: 331A: 211; 331B: 331A.  
331A Principles and methods of persuasive speaking, discovery and use of evidence, proof, refutation; appeals; organization of persuasive speeches upon topics of current interest. 331B: An examination of research 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.  
Prerequisite: 211.  
336A: Practice and procedures of problem-solving groups, communication theories related to group procedure and participation. 336B: Theories of group leadership in the specialized forms of group discussion, symposium, role-playing, forums.

340. AMERICAN PUBLIC ADDRESS.  
(3-0) Cr. 3. S.  
Prerequisite: 211.  
Analysis of the relations between speakers, speeches and political or historical events.

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.  
Prerequisite: 120.  
Improvisation 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: 120.  
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: 375.  
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.  
(1-3 to 9) Cr. 1 to 3 each time elected.  
400A: Maximum of 6 credits; 400B: Maximum of 10 credits; 400C: Maximum of 8 credits. 400A, 400C: F.W.S.; 400B: F.W.SSSI.  
Prerequisite: 400A: 302, 301 or Tech. Jl. 475, Engl. 315, permission of instructor.
400B: 206, 301, 302, 326, 328, Engl. 315, Tech. Jl. 475, permission of instructor. 
400C: 400B, Tech. Jl. 476, permission of instructor.

400A: Creating, writing, and directing of a variety of educational and public information programs. Research methods; narrative and expositional writing techniques; audio control; direction of talent, production procedures. Selected programs each week on WOI-FM-AM. 400B· Television. Students who have emphasized in earlier work, 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.

405. SPEECH CRITICISM. (3-0) Cr. 3. S.
Prerequisite: 9 credits of Speech and permission of instructor.

Development of speech theory and practice from Corax to modern times. Application of principles of criticism to current public speaking practices.

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.SI. Staff.
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.

COURSES PRIMARILY FOR GRADUATE STUDENTS, for minor only, open to qualified undergraduates

599. SPECIAL TOPICS.
Cr. 2 to 6 each time taken. Maximum of 18. F.W.S.SI.SSI.
Prerequisite: Permission of department chairman.

A. Speech Education
B. Speech Correction.
C. Advanced Speech Analysis.
D. Telecommunicative Arts.
Telecommunicative Arts

Television, Radio, Motion Pictures for Television

George P. Wilson, Jr., Ph.D., Director of Telecommunicative Arts Training Program

Iowa State University is interested in educating students in television, radio and motion pictures, either (a) for full-time professional work in these fields, or (b) as background or minor study adapted to the needs of students from departments in Agriculture, Home Economics, Engineering, or Sciences and Humanities. Study in telecommunications often holds career possibilities for students whose major study lies elsewhere. Courses in production, direction, programming, performance, writing, management, news, advertising and sales are offered in cooperating departments: Applied Art, Architecture, Economics, Electrical Engineering, English and Speech, Household Equipment, Industrial Administration, Music, Psychology, Statistics and Technical Journalism.

Students wishing to concentrate in radio and television should choose the option in telecommunicative arts, offered in the Department of English and Speech. Students from other colleges and departments wishing work in radio and television in connection with major programs outside this field may take regular minor programs or selected courses.

The broadcasting, film, and closed circuit facilities and laboratories of the University are regularly utilized by students in telecommunicative arts. The University's radio station, WOI, has been a pioneer in educational broadcasting since 1922. The nation's first educationally owned television station, WOI-TV, has operated since 1950.

A unique opportunity in telecommunications at Iowa State is the summer apprenticeship program. Since 1953 over 100 advanced students have been placed with commercial and educational stations throughout the country for the three-month summer period.

ENTOMOLOGY

For description of courses, see Zoology and Entomology

FARM OPERATION

For information about this curriculum, see College of Agriculture. Curricula

FISHERIES AND WILDLIFE BIOLOGY

For description of courses, see Zoology and Entomology

FOOD AND NUTRITION

Wilma D. Brewer, Ph.D., Head of Department

Professors: Lotte Arnrich, Ph.D.; Mary Agnes Frances Carlin, Ph.D.; Ercel S. Eppright, Ph.D.; Thelma J. McMillan, Ph.D.; E. Madge Miller, Ph.D.; Charlotte F. Roderuck, Ph.D.; Pearl Swanson, Ph.D.

Associate Professors: Pilar Garcia, Ph.D.; Jewel B. Graham, M.S.; Maxine A. Hinton, Ph.D.; Phyllis J. Olson, M.S.; Nelle E. Thompson, M.A.

Assistant Professors: Mary Alice Kenney, Ph.D.; Diane McComber, M.S.; Evelyn Mar, M.S.;

Instructors: Joan B. MacMillan, M.S.; Charlene Martinsen, M.S.; Elnor V. Niffenegger, M.S.; Ruth L. Smith, B.S.
Opportunities for 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: food science, community nutrition, dietetics, and food and nutrition and related 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 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.

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.

Opportunities for 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, bacteriology, food technology, psychology, physiology, economics, statistics or technical journalism. For the language requirement see the Graduate College.

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.
Prerequisite: Zool. 155.
The selection and use of food for health and satisfaction of the individual and the family.

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.
301. FOOD AND MEAL MANAGEMENT. (0-6) Cr. 3. W.
Prerequisite: Junior or senior classifica-
tion.
For students not in the College of Home
Economics. A survey of selected areas of
nutrition, food preparation, management
and consumer economics; the relation of
these to feeding the family. Choice, purchase,
preparation and service of food for family
meals.

302. NUTRITION OF THE CHILD AND
THE FAMILY. (3-0) Cr. 3. Alt. W. Offered 1969.
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. (1-6) Cr. 3. 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.

304. NUTRITION AND DIETETICS. (3-3) Cr. 4. F.W.S.SSI.
Prerequisite: B. & B. 301 or 304; Zool. 155 or 355.
Physiological and chemical bases for nu-
trient needs; factors to consider in satisfying
these needs for individuals and populations
of food;

320. FUNDAMENTALS OF FOOD
MEASUREMENTS. (1-6) Cr. 3. S.
Prerequisite: 215, 303; Physics 106 or 111,
Soc. 218. Advance reservation required.
Basic concepts and principles of the assess-
ment of foods; introductory aspects of sub-
jective 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 labora-
tories and experimental test kitchens.

404. SEMINAR IN FOOD AND NUTRITION. (2-0) Cr. 2. F.W.
Prerequisite: 305.
Orientation to professional work; state, na-
tional and international problems in food
and nutrition.

409. DIET THERAPY. (3-0) Cr. 3. F.W.
Prerequisite: 305.
Basic biochemical and physiological con-
ditions 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 repro-
duction; problems in feeding infants,
children, and women during the reproduc-
tive period; indices of growth and develop-
ment.

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 population groups which have a high
incidence of malnutrition; discussion of
community programs designed to help
solve problems. Field trips in conjunction
with programs of Iowa State Department of
Health and Cooperative Extension Serv-
ices are scheduled.

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 nu-
trition programs.

415. INTRODUCTION TO NUTRITION
RESEARCH. (0-9) Cr. 3. F.W.S.
Prerequisite: 305, B. & B. 305, Chem. 211
or B. & B. 311; permission of instructor.
Introduction to methods used in nutrition
research with application to selected
problems.

418. METHODS OF TEACHING
NUTRITION. (3-0) Cr. 3. S.
Prerequisite: 409, H.Ed. 415.
Objectives, organization of subject matter,
practical application of methods and tech-
niques for teaching patients, medical and
dietetic interns, student nurses and em-
ployees.

420. HISTORY OF FOOD. (1-3) Cr. 2. F.
Prerequisite: 320, 9 credits in Social Sci-
ences.
Study of our food heritage; historical per-
spectives 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, H.Ed. 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.
Prerequisite: 421.
Experimental approach to the study of fats
and oils and meats.

423. INTRODUCTION TO RESEARCH IN
FOOD SCIENCE. (1-6) Cr. 3. S.
Prerequisite: 422.
Guidance and individual experience in plan-
ning, executing and reporting a problem
in food research. Interpretation and evalua-
tion of pertinent literature.

490. SPECIAL PROBLEMS. Cr. arr. F.W.S.SSSI.
Prerequisite: Permission of instructor.
COURSES PRIMARILY FOR GRADUATE STUDENTS, major or minor, open to qualified undergraduates

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 interactive components of selected foods, correlated emphasis on selection, application, and evaluation of pertinent literature.  
523: Individual design, execution and summarization of the laboratory investigation of a problem in food research. Emphasis on development of critical evaluation and interpretation of data and supporting literature.

550. PROCESSED FOODS.  
(3-0 or 6) Cr. 3 or 5. 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.S.SII.  
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.  
Kenny.  
Application of chemical techniques to research in nutrition

607A. 607B. ANIMAL EXPERIMENTATION IN NUTRITION RESEARCH.  
607A: (1 0 or 1-3) Cr. 1-2 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. 0. F.W.S.S Staff.  
Required of all graduate majors in the Food and Nutrition Department

614. RESEARCH.  
F.W.S.S.SII.  
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.  
See Animal Science.

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.

Associate Professors: Tereze Michelsons, M.A.; Osvaldo Soto, Dr. en Der

Assistant Professors: Robert Bernard, M.A.; Floyd Pace, M.S.; Franz J. Pfister, M.A.; Fred Pohorile, M.A.

Opportunities for Undergraduate Study

The instruction offered in the Department of Foreign Languages is designed to give students the basic fundamentals in the languages offered and to introduce them to the culture of the people whose language is being studied.

The department offers a regular academic major with a minimum of 30 credits and two minors in other departments with a total of 30 credits. A minor in foreign languages may be taken with 15 credits beyond 9 credits of the elementary course. However, if the major student wishes to qualify for a teacher's certificate in foreign languages he 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 (Distributed Studies 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 Teacher Certification.

Students entering the University with one 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 one or more year's instruction at the high school level. Students from foreign countries will not be permitted to enroll in courses below the 400 level in their native languages.

Opportunities for teaching foreign languages in public schools are excellent at this time. Students who wish to prepare themselves for this field should plan to take four years of one language, two of a second and a concentration in one other field; for example, English, social studies, general science or mathematics.

Students who wish to specialize in international affairs may do so through the International Service Program while majoring in foreign languages. See International Service Program.

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.

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.
Courses in German

131, 132, 133. ELEMENTARY GERMAN. (3-2) Cr. 4 each. 131: F.W.; 132: W.S.; 133: S.
Prerequisite: 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.

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.

236, 237, 238. INTERMEDIATE GERMAN. (3-0) Cr. 3 each. Yr.
Prerequisite: 236: 133, 133A or equivalent; 237: 236; 238: 237.

239, 240, 241. GERMAN CIVILIZATION. (3-0) Cr. 3 each. Yr.
Prerequisite: 133, 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.
Prerequisite: 339: 18 credits in German; 340: 339; 341: 340. Required of German majors.
Thorough review of German grammar. Practice in writing and speaking German.
342, 343, 344. EIGHTEENTH CENTURY
GERMAN LITERATURE.
(3-0) Cr. 3 each Yr.
Prerequisite: 18 credits in German.
Selected readings from the works of Lessing, Goethe, Schiller, and others of the period

345, 346, 347. GERMAN LITERATURE FROM
1800 TO THE PRESENT.
(3-0) Cr. 3 each Yr.
Prerequisite: 18 credits in German.
Selected readings from the works of prominent writers of the time

Courses in Russian

121, 122, 123. ELEMENTARY RUSSIAN.
(4-0) 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. Optional one-hour laboratory without credit.

224, 225, 226. INTERMEDIATE RUSSIAN.
(3-0) Cr. 3 each Yr.
Prerequisite: 224: 123 or equivalent; 225: 224 or equivalent; 226: 326 or equivalent.

Courses in Spanish

151, 152, 153. ELEMENTARY SPANISH.
(3-2) Cr. 4 each 151. F.W.; 162. W.S.;
153. S.
Prerequisite: 151: Elementary sequence open only to students with no previous instruction in Spanish. 152: 151; 153: 152.
Essentials of construction and vocabulary with an oral approach and with use of the language laboratory.

251, 252, 253. INTERMEDIATE SPANISH.
(2-2) Cr. 3 each Yr.
Prerequisite: 251: 153 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, 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.

440. GOETHE'S FAUST, PART I.
(3-0) Cr. 3. F.
Prerequisite: 344 or 347.
Reading of Faust, Part 1, with discussions in German only.

441. 442, 443. ADVANCED GERMAN COMPOSITION AND CONVERSATION.
(3-0) Cr. 3 each Yr.
Prerequisite: 238 or equivalent. Required of all German majors.
Intensive practice in composition and conversation, using literary masterpieces as a basis for written and oral discussion.

324, 325, 326. ADVANCED RUSSIAN.
(3-0) Cr. 3 each Yr.
Prerequisite: 18 credits in Russian or equivalent.
Composition and conversation based on masterpieces of Russian literature. Survey of Russian literature from the 10th Century to the present.

494, 495, 496. ADVANCED RUSSIAN COMPOSITION AND CONVERSATION.
(3-0) Cr. 3 each Yr.
Prerequisite: 494: 326; 495: 494; 496: 495.
Extensive practice in writing and speaking Russian. Required of Russian majors.

354, 355, 356. ELEMENTARY SPANISH COMPOSITION AND CONVERSATION.
(3-0) Cr. 3 each Yr.
Prerequisite: 354: 253; 355: 254; 356: 255.
Practice in writing and speaking Spanish with emphasis on usage rather than grammar and structure of the language.

464, 465, 466. INTRODUCTION TO LATIN AMERICAN LITERATURE.
(3-0) Cr. 3 each Yr.
Prerequisite: 36 credits in Spanish or equivalent.
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: 363 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.

471. INTRODUCTION TO CERVANTES.
(3-0) Cr. 3. S.
Prerequisite: 36 credits in Spanish or equivalent.
Reading of selected illustrative parts of the Quixote and minor works of Cervantes.
Description of Courses

472. SPANISH DRAMA OF THE NINETEENTH AND TWENTIETH CENTURIES.
(3-0) Cr. 3. S.
Prerequisite: 36 credits in Spanish or equivalent.
Reading of selected illustrative material from the drama of the period

Special Courses

476. METHODS OF TEACHING FOREIGN LANGUAGES.
Cr. 3. W.
Prerequisite: 15 credits in foreign languages.

499. SPECIAL PROBLEMS.
Cr. 1-9 each time elected. F.W.S.
Prerequisite: Permission of department head.

FORESTRY


Associate Professors: Ian M. Campbell, Ph.D.; Raymond F. Finn, Ph.D.; Frederick S. Hopkins, Jr., Ph.D.; Julius A. Larsen, Ph.D.; Kenneth D. Ware, Ph.D.

Assistant Professors: Dean R. Prestemon, Ph.D.; J. D. Wellons III, Ph.D.

Instructor: Victor G. Smith, M.Sc.F.

Opportunities for 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.

Opportunities for Graduate Study

The department offers programs leading to the degrees Master of Forestry, Master of Science in forest economics, forest management, forest mensuration, silviculture, and wood technology, and the degree Doctor of Philosophy in forest economics, forest mensuration, silviculture, 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.

The foreign language requirement for the degrees Master of Forestry and Master of Science may be waived upon recommendation of the department head.


COURSES PRIMARILY FOR UNDERGRADUATE STUDENTS

101. INTRODUCTION TO FORESTRY.
(3-3) Cr. 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

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 studies 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

220. FARM FORESTRY.
(2-2) Cr. 3. F.
Prerequisite 203.
Place of forestry on the farm Establishment, protection and management of plantations windbreaks and woodlot products Field demonstrations Not open to forestry students

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.

301. SILVICS.
(4-0) Cr. 4. W.
Prerequisite Bot. 310, Gen. 301 and credit or classification in Agron. 357.
effects of genetic and environmental factors on tree processes underlying forest tree production.

302. SILVICULTURE.
(3-3) Cr. 4. S.
Prerequisite 301.
Forest vegetational units: development and classification Practice of silviculture with application to species, types and regions in the United States.

356. DENDROLOGY.
(3-0) Cr. B. See Botany.

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 or 210.
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 Transporting, 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) Cr. 3. F.
Prerequisite Bot. 101 or 210.
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.
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.**

(But. 416) See Botany.

417. **WOOD DETERIORATION.**

(But. 117) See Botany.

440. **SPECIAL PROBLEMS.**

Cr. 2 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**

(2-2) Cr. 3. W. (Not offered W. 1968)
Prerequisite: 241 and credit or classification in 441.

444. **FOREST RESOURCE SURVEYS.**

(4-0) Cr. 4. Alt. S. Offered 1969.
Prerequisite: 241, or Stat. 201.
Survey of objectives, problems and methods of quantification and inventory of various forest resources and uses including range, 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.**

(1-9) 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.

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 of land use changes. Economic analysis of recreation in the United States and Canada; forest recreation in individual states.

171. **FORESTRY OPERATIONS ANALYSIS.**

(2-3) Cr. 3. F.
Prerequisite: 211, 170, 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 FORESTY.**

(4-3) Cr. 5. S.
Prerequisite: 470.
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.**

(2-3) Cr. 3. Alt. W. Offered 1968.
Prerequisite: 350; 389 recommended.
Chemical processing of cellulose derived products. Carbonization, destructive distillation, hydrolysis; dimensional stabilization; wood-plastic combinations.

481. **PROPERTIES OF WOOD.**

(3-9) Cr. 3. Alt. SS. Offered 1968.
Prerequisite: 1. Ed. 205.
Structure and identification of wood; storage and handling of lumber; seasoning and other defects in lumber; machining and preparation of wood for gluing; woodworking glues. Not open to forestry majors.

487. **MECHANICAL PROCESSING AND WOOD FINISHING.**

(3-3) Cr. 4. S.
Prerequisite: 380.
Mechanical processing sawing, planing, sanding, chipping, and delignification. Veneer, plywood and composite boards. Interior and exterior finishing of wood. Application and serviceability of wood in building construction.

488. **PHYSICAL PROPERTIES OF WOOD.**

(3-3) Cr. 4. Alt. W. Offered 1969.
Prerequisite: 380, Phys. 111 or equivalent.
Wood in relation to heat, light, sound, and electricity. Introduction to wood mechanics.

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. ADVANCED SILVICULTURE. (3-0) Cr. 3. Alt. S. Offered 1968. Gatherum.
Prerequisite: 302.
Detailed analysis of the practice of silviculture in relation to silvicultural principles

540. SPECIAL TOPICS.
Cr. 2 to 5 each time elected. F.W.S.
Prerequisite: 15 credits of acceptable graduate work. Permission of instructor.
A. Silviculture. Gatherum.
C. Forest Management. Thomson.
D. Forest Economics. Hopkins.
E. Range Management.
F. Forest Mensuration and Photogrammetry. Thomson, Ware.

543. FOREST MENSURATION. (2-3) 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 and critical analysis of related research.

COURSES FOR GRADUATE STUDENTS, major or minor

600. RESEARCH.
Cr. 1-11. F.W.S.SSI.SSI
A. Silviculture. Gatherum, Finn
C. Forest Economics. Hopkins.
D. Forest Management. Thomson.
E. Forest Mensuration and Photogrammetry. Thomson, Ware.

601. RESEARCH METHODS IN FORESTRY. (2-2) Cr. 3. W.
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 SILVICS. (3-0) Cr. 3. Alt. S. Offered 1968.
Prerequisite: 302. Gatherum.
Detailed analysis of tree processes underlying forest tree production in relation to genetic and environmental factors.

645. ADVANCED FOREST MENSURATION. (4-0) Cr. 4. Alt. S. Offered 1968.

577. ADVANCED FOREST PATHOLOGY. (Bot. 577) See Botany.

580. CHEMISTRY OF WOOD. (3-0) Cr. 3. Alt. W. Offered 1969.
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 1968.
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. F.
Prerequisite: 381. Bensend.
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.

600. RESEARCH.
Cr. 1-11. F.W.S.SSI.SSI
A. Silviculture. Gatherum, Finn
C. Forest Economics. Hopkins.
D. Forest Management. Thomson.
E. Forest Mensuration and Photogrammetry. Thomson, Ware.

601. RESEARCH METHODS IN FORESTRY. (2-2) Cr. 3. W.
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 SILVICS. (3-0) Cr. 3. Alt. S. Offered 1968.
Prerequisite: 302. Gatherum.
Detailed analysis of tree processes underlying forest tree production in relation to genetic and environmental factors.

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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.

GENETICS

William J. Welshons, Ph.D., Head of Department

Professors: Willard F. Hollander, Ph.D.; Donald S. Robertson, Ph.D.

Associate Professors: Wilmer J. Miller, Ph.D.; Peter A. Peterson, Ph.D.; Kiyoshi Sadanaga, Ph.D.; Peter E. Thompson, Ph.D.

Assistant Professors: Howard T. Bausum, Ph.D.; Edward Pollak, Ph.D.

Instructor: Darrel S. English, M.S.
### Opportunities for Undergraduate Study

For undergraduate curriculum in sciences and humanities leading to the degree Bachelor of Science, with a major or minor in genetics, see *Sciences and Humanities, Curriculum*

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.

### Opportunities for 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 only: 401, 460.

### COURSES PRIMARILY FOR UNDERGRADUATE STUDENTS

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Description</th>
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<tbody>
<tr>
<td>301.</td>
<td>INTRODUCTORY GENETICS. <em>(3-0)</em> 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.</td>
</tr>
<tr>
<td>305.</td>
<td>ELEMENTARY GENETICS LABORATORY. <em>(0-9)</em> Cr. 3. F.W.S. Prerequisite: Should accompany or follow 301 or 400. Laboratory experiments illustrating the laws of heredity and their physical basis</td>
</tr>
<tr>
<td>400.</td>
<td>HUMAN HEREDITY. <em>(3-0)</em> Cr. 3. S. Principles of heredity in man, the relation of inheritance to disease, blood types, legal medicine, and eugenics.</td>
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</table>

### COURSES PRIMARILY FOR GRADUATE STUDENTS, major or minor, open to qualified undergraduates

<table>
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<tr>
<th>Course Code</th>
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<tbody>
<tr>
<td>401.</td>
<td>INTERMEDIATE GENETICS. <em>(3-0)</em> Cr. 3. F. Prerequisite: 301 or 400. Fundamental methods and concepts in genetics chromosome mapping, gene structure, elementary mathematical genetics, polyploidy, and meiotic analysis.</td>
</tr>
<tr>
<td>450.</td>
<td>SPECIAL PROBLEMS. Cr. arr. F.W.S.SSI,SSII. Prerequisite: 305, 401.</td>
</tr>
<tr>
<td>460.</td>
<td>INTRODUCTION TO MATHEMATICAL GENETICS. <em>(3-0)</em> Cr. 3. S. Prerequisite: 401, Math. 101 or equivalents. Elementary probability and its application to Mendelian, population, and quantitative genetics.</td>
</tr>
</tbody>
</table>

Both courses cannot be used for graduation credit.

### COURSES FOR GRADUATE STUDENTS, major or minor

<table>
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<tr>
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<tbody>
<tr>
<td>540.</td>
<td>SPECIAL TOPICS.</td>
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<tr>
<td>536.</td>
<td>CYTOGENETICS. <em>(Bot. 605)</em> See Botany.</td>
</tr>
<tr>
<td>540.</td>
<td>PRINCIPLES OF GENETIC ANALYSIS. <em>(3-0)</em> Cr. 3. F. Prerequisite: 401. Thompson. Methods of genetic investigation, with emphasis on mutation, gene action, chromosome organization and the properties of the genetic material.</td>
</tr>
</tbody>
</table>
620. BIOCHEMICAL GENETICS.  
(Bact. 620) (3-0) Cr. 3. S.
Prerequisite: 401. Bausum.
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.
Genetic analysis of plants including the study of linkage, translocations, inversions, polyploidy and evolution.

635. ANIMAL GENETICS.  
(3-2) Cr. 4. 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 1967.
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.  
(2-6) Cr. 5. Alt. P. Offered 1967.
Prerequisite: 401. Miller.
Application of immunological principles to genetics; analytical procedures of blood typing; individual and species variation.

650. SEMINAR.  
Cr. 1. F.W.S. Welsongs.

654. GENETICS OF BREED IMPROVEMENT.  

655. BREEDING SYSTEMS AND PLANS.  

660. RESEARCH.  
F.W.S.SSII,SSIII. Hollander, Miller, Peterson, Robertson, Sadanaga, Thompson, Welsongs.

698. SEMINAR IN CELL BIOLOGY.  

HISTORY, GOVERNMENT AND PHILOSOPHY
Ross B. Talbot, Ph.D., Chairman of Department


Associate Professors: Don F. Hadwiger, Ph.D.; James B. Hartman, Ph.D.; V. Alton Moody, Ph.D.; Barbara Teters, Ph.D.

Assistant Professors: Hugh S. Lehman, Ph.D.; Glenn O. Nichols, Ph.D.; Monte Palmer, Ph.D.; Rolf W. Theen, Ph.D.; Richard J. Vanlten, Ph.D.; Robert I. Wessel, M.S.; Charles W. Wiggins, Ph.D.; James W. Whitaker, Ph.D.; Philip B. Zaring, Ph.D.

Instructors: Achilles Avraamides, M.A.; George T. McJimsey, M.A.

Opportunities for Undergraduate Study

The department provides general introductory courses in history, government and philosophy designed for all students to serve either as a part of their general education or as a background for further work in any of the three fields. The department also offers courses for students who need a knowledge of history, government or philosophy as a corollary to or preparation for their vocational training.

The department offers majors in history, or government, or philosophy, and courses are offered to provide advanced undergraduate work in the areas of American history, European history, the history of science, international relations, government and philosophy.

Undergraduates majoring in other departments may take minors in either history, government, or philosophy.

Students who wish to specialize in the study of international affairs may do so through the International Service Program while majoring in history or government. See International Service Program.

The department presents the opportunity of preparation for the study of law by completion of three years in its curriculum followed by one year satisfactorily completed in a recognized college of law, after which the degree Bachelor of Science with a major in history or government will be awarded by Iowa State University.
Undergraduate majors in history usually have included the following basic courses in their programs: 205, 206, 207 and 321, 322, 323. Majors in government usually include 215, 241, 305. Majors in philosophy usually include 260, 331, either 350 or 370, 441, 442, 443. As supporting work, undergraduate majors have found the following courses desirable: Econ. 241, 242; Soc. 134; Engl. 354, 363. 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 counselors who wish to estimate the amount of basic, non-specialized study which may be needed.

Opportunities for Graduate Study

The department offers major work for the degree Master of Science in either history or government, and minor work in history, government, and philosophy to students taking major work in other departments. The department also offers the degree Master of Science in the History of Science and Technology.

Prerequisite to major graduate work in the department is the completion of at least 30 credits in history or government.


Courses in History

COURSES PRIMARILY FOR UNDERGRADUATE STUDENTS

205, 206, 207. INTRODUCTION TO WESTERN CIVILIZATION.
(3-0) Cr. 3 each. 205: F.W.; 206: W.S.; 207: F.S.
Social and cultural development of Western civilization from the Ancient Orient to the present, emphasizing economic and political institutions, changes in habits, customs, and ideas; the background of recent developments

* 321, 322, 323. HISTORY OF THE AMERICAN NATION.
(3-0) Cr. 3 each. Smith, McJimsey. 321: F.W.; 322: W.S.; 323: S.
321 National foundations. Colonial background, revolution, confederation and constitution, nationalism and democracy 322 National expansion and internal conflict Forces of unity and division, division and reunion 323 National consolidation and world power; emergence of the new nation, modern industrialism and international relations

324. HISTORY OF AMERICAN AGRICULTURE.
(3-0) Cr. 3. F.W.S. Whitaker.
Colonial foundations, westward movement, public land policies, regional specialization, transportation and markets, science and technology, relation of state to agriculture

* 334. 335. ECONOMIC HISTORY OF THE UNITED STATES.
(3-0) Cr. 3 each. 334: F; 335: W.S.
Prerequisite: Sophomore standing. Sharlin. 334 To 1865 335 Since 1865 Growth of important industries, development of economic institutions, relation of government to business enterprise

* 355, 356, 357. HISTORY OF ENGLAND AND GREAT BRITAIN.
(3-0) Cr. 3 each Yr. Zaring.
355. Anglo-Saxon period and the Norman conquest; constitutional and cultural developments in the medieval period 356 The age of the Tudors and Elizabethan England (Constitutional and religious issues in Stuart England, emergence of modern political institutions, growth and loss of empire, industrial revolution; struggle against the Napoleonic Empire. 357 Victorian Age and the climax of the British Empire, Great Britain and World War I, the inter-war period and World War II

369. PRE-MODERN EAST ASIAN HISTORY.
(3-0) Cr. 3. F.
Prerequisite: 6 credits in History. Teters.
A survey of political, economic, intellectual, cultural and social developments of China, Japan, and Korea from earliest times to 1600.

370. THE FAR EAST IN MODERN TIMES.
(3-0) Cr. 3. W.
Prerequisite: 369. Teters.
Early impact of Europe on the Far East, emergence of China and Japan as important nations in the nineteenth century; rise of Japan as a world power and the rise of nationalism in the twentieth century, revolutionary movements in East Asia since World War II.
401. 402. ECONOMIC HISTORY OF MODERN EUROPE.
(3-0) Cr. 3 each. W.S.
Prerequisite: 6 credits in History. Nichols.
401. Economic and political revolutions 1750-1900: English and Continental heritage from medieval Europe; commercial, industrial, agricultural revolutions, economic institutions and reforms; capitalism, competition, imperialism. 402: Rise of Continental industry; changes in labor, transportation, markets, reparations, revolutions, reconstruction, competition, depression and war.

405A, 405B, 405C. ANCIENT HISTORY.
(3-0) Cr. 3 each. 405A: F; 405B: W; 405C: S.
Prerequisite: 205. Avraamides.
405A: Ancient Near East; Mesopotamia and Egypt to 500 B.C. 405B: Ancient Greece; history of Greece from prehistoric times to death of Alexander. 405C: Ancient Rome; history of Rome from prehistoric times to the reign of Constantine.

406A, 406B. MEDIEVAL EUROPE.
(3-0) Cr. 3 each. 406A: W; 406B: S.
Prerequisite: 205. Avraamides.
406A: The Carolingian and Merovingian periods. Roman-Germanic fusion, emergence of feudalism and manorialism. 406B: The ecclesiastical civilization; the Crusades, popes and emperors; the thirteenth century climax or medieval culture.

407A, 407B. THE RENAISSANCE AND REFORMATION.
(3-0) Cr. 3 each. 407A: F; 407B: W.
Prerequisite: 206. Avraamides, Zaring.
407A: The Italian Renaissance, emergence of towns and cities, growth of a secularized society, early expansion of Europe, new intellectual interests. 407B: The High Renaissance, emergence of religious dissent, the Protestant Revolt, end of universality of the Church, era of religious wars, the emergence of dynasties, development of capitalism and the Commercial Revolution.

425A, 425B. TWENTIETH CENTURY EUROPE.
(3-0) Cr. 3 each. 425A: F; 425B: W.
Prerequisite: 207. Matterson.
425A: Europe on the eve of war of 1914, the war and its effect intellectually, economically, politically; rise of totalitarianism. 425B: The depression and the breakdown of international relations in the 1930's, World War II and its results.

440. HISTORY OF SCIENCE FROM THE BEGINNINGS TO COPERNICUS.
(3-0) Cr. 3. F.
Prerequisite: 6 credits in History. Sharlin.
Development of natural science in Babylonia, Egypt, China, India; Greek science, medieval and Arabic science.

441. BEGINNINGS OF MODERN SCIENCE.
(3-0) Cr. 3. W.
Prerequisite: 6 credits in History. Sharlin.
The sixteenth, seventeenth, and eighteenth century revolutions in astronomy, mechanics, biology and chemistry. Rise of scientific societies and the experimental method.

442. HISTORY OF MODERN SCIENCE.
(3-0) Cr. 3. S.
Prerequisite: 6 credits in History. Sharlin.
Developments of physics, chemistry and biology in the nineteenth and twentieth centuries.

450. HISTORY OF MODERN RUSSIA.
(3-0) Cr. 3. S.
Prerequisite: 6 credits in History. Matterson.
Emergence of Russia in the eighteenth century as a European power; Tsarist Russia as the stronghold of autocracy in the nineteenth century; background of the Revolution of 1917; the Revolution and the Lenin period; the Stalin period.

461. MODERN JAPANESE HISTORY.
(3-0) Cr. 3. Alt. S. Offered 1969.
Prerequisite: 370. Teters.
Political, cultural, social and economic history of Japan, particularly since 1853.

465. HISTORY OF LATIN AMERICA.
(3-0) Cr. 3. W.
Prerequisite: 6 credits in History. Smith. Spanish and Portuguese colonization in America; colonial institutions; wars of independence; development of Argentina, Brazil, Chile, and Mexico; emphasis on Pan-Americanism and relations of the United States with Latin America.

467. COLONIAL AMERICA.
(3-0) Cr. 3. F.
Prerequisite: 6 credits in history including 321. Whitaker.
Expansion of Europe and colonial foundations Economic, political, and social development to 1763.

470. SECTIONAL CONFLICT AND THE CIVIL WAR.
(3-0) Cr. 3. F.
Prerequisite: 322. Smith.
Intensive study of the economic, social, political, and psychological conflicts which undermined the democratic process and drove the United States to Civil War.

472. THE RECONSTRUCTION ERA 1865-1877.
(3-0) Cr. 3. W. McJimsey.
Major social and political features of the United States following the Civil War: The decision to reconstruct the South. Accomplishments and failures of reconstruction.

480. RECENT AMERICAN HISTORY, 1929 TO PRESENT.
(3-0) Cr. 3. S.
Prerequisite: 6 credits in history including 323.
History of the United States during the depression and the New Deal, World War II, and the Cold War.

495. SPECIAL PROBLEMS.
Cr. 2 to 5 each time elected.
Prerequisite: Permission of department head.
Staff.
Reading and reports on problems selected in conference with each student.
H Honors Program.

COURSES FOR GRADUATE STUDENTS, major or minor, open to qualified undergraduates

510. SCIENCE AND MODERN THOUGHT FROM 1500 TO PRESENT.
(3-0) Cr. 3. S.
Prerequisite: 9 credits in history. Sharlin. Interactions of science with social, political and economic thought.

515. HISTORY OF TECHNOLOGY IN THE UNITED STATES.
(Engineering 515) See Engineering.

522. SOCIAL AND INTELLECTUAL HISTORY OF THE UNITED STATES.
(3-0) Cr. 3. S.
Prerequisite: 9 credits in history and government. McJimsey. Development of social and intellectual movements, institutions, and leaders.

526. DEVELOPMENT OF THE UNITED STATES CONSTITUTION TO 1865.
(3-0) Cr. 3. F.
Prerequisite: 9 credits in history or government. Boles. Constitutional heritage from England, colonial contributions to constitutional development, making the Constitution, problems of the new government, development of constitutional activities through Supreme Court decisions, effect of the Civil War on the Constitution

527. DEVELOPMENT OF THE UNITED STATES CONSTITUTION SINCE 1865.
(3-0) Cr. 3. W.
Prerequisite: 9 credits in history or government. Boles. Constitutional significance of the World Wars, the Progressive movement and the New Deal.

534. THE WESTWARD MOVEMENT.
(3-0) Cr. 3. F.
Prerequisite: 9 credits in history. Whitaker. The West under Spain, France and England, territorial acquisitions, westward migration to the Mississippi; economic, political and social development of the frontier, settlement of the prairie states.

535. THE TRANS-MISSISSIPPI WEST.
(3-0) Cr. 3. W.
Prerequisite: 9 credits in history. Whitaker. Exploration and settlement of the Great Plains and Rocky Mountain areas, the development of fur trade, cattle and mining kingdoms, social and institutional modifications, passing of the frontier, effect of the Far West on national development

554. FOREIGN RELATIONS OF THE UNITED STATES, 1775-1898.
(3-0) Cr. 3. F.
Prerequisite: 9 credits in history and government. Smith. European background; French alliance and independence; struggle for neutrality; Monroe Doctrine; diplomacy of westward expansion; War between States; economics of diplomacy.

555. UNITED STATES AS A WORLD POWER SINCE 1898.
(3-0) Cr. 3. W.
Prerequisite: 9 credits in history and government. Smith. The "New Manifest Destiny" of the United States; American interests and policies in Europe, Latin America, and the Far East; isolation to intervention in the World Wars of 1914 and 1939, the United States in the postwar world.

556. SOVIET FOREIGN POLICY.
(Engineering 556) See Government.

561. TECHNOLOGY IN DEVELOPING COUNTRIES.
(Engineering 561) See Engineering.

570. THE JACKSONIAN MOVEMENT.
(3-0) Cr. 3. Alt. S.
Prerequisite: 9 credits in history or government. Smith. Origins, development and significance of Jacksonian democracy in determining and revealing the nature of American economic, social and political mores and institutions.

580. SEMINAR IN HISTORY.
(3-0) Cr. 3. F.W.S.

590. SPECIAL TOPICS IN HISTORY.
Cr. 2 to 5 each time elected. F.W.S.

COURSES FOR GRADUATE STUDENTS, major or minor

604. RESEARCH IN HISTORY.
Staff.

Courses in Government

COURSES PRIMARILY FOR UNDERGRADUATE STUDENTS

215. AMERICAN GOVERNMENT.
(3-0) Cr. 3. F.W.S.
Prerequisite: English 103 or 132. Fundamentals of democracy: nature of federalism, fundamentals of the Presidential, 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. Staff.
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. Staff.
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; state and local institutions.

310. STATE AND LOCAL GOVERNMENT. (3-0) Cr. 3. S.
Prerequisite: 215; 305 recommended. Wiggins.
Organization and functions; state regulations and operation; special problems including reorganization of state and local government; consolidation of government areas; financial control; state civil service.

311. MUNICIPAL GOVERNMENT AND ADMINISTRATION. (3-0) Cr. 3. F.S.
Prerequisite: 215; 305 recommended. Wessel.
Rise of city in American life; legal position of municipal corporation; forms of organization; personnel and financial administration; planning; streets and lights; police and fire administration; public health; recreation; water supply; sanitation; schools; libraries; public welfare administration; utility regulation.

330. INTRODUCTION TO POLITICAL BEHAVIOR. (3-0) Cr. 3. F.
Prerequisite: 215. Wiggins.
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.

340. POLITICS OF DEVELOPING AREAS. (3-0) Cr. 3. S.
Prerequisite: 241. Palmer.
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. S.
Prerequisite: 352; 351; 353: 352. Palmer.
351: Analysis of how traditional concepts of international relations have been altered by advent of nuclear weapons. Nuclear strategy, arms control, and international organizations and law as instruments for the reconciliation of international conflict.
352: Comparative analysis of foreign policies of United States, Western Europe, and the Communist Bloc. Advantages and dis-advantages of foreign policy making under democratic political systems.
353: International interaction between major powers and developing areas. Foreign aid, bloc politics in the United Nations, and the various Afro-Asian conferences and alignments.

360. CONGRESS AND THE STATE LEGISLATURES. (3-0) Cr. 3. F.
Prerequisite: 215. Hadwiger.
Theory of representation in democratic government. Organization, procedures, voting patterns and leadership roles of United States Congress and state legislatures.

420. CONSTITUTIONAL LAW. (3-0) Cr. 3. F.
Prerequisite: 315; 305 recommended. Boles.
Development of the United States Constitution through judicial action; influence of public law and judicial interpretations upon American government and society.

421. CIVIL LIBERTIES. (3-0) Cr. 3. W.
Prerequisite: 420. Boles.
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: 351. Boles.
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: 305 or 241. Talbot.
Major political writings from Plato to Bodin. Primary emphasis on the study of translations of original works. 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: 430.
Major political philosophers from Bodin to Bentham.

432. DEVELOPMENT OF POLITICAL THOUGHT: 19th-20th CENTURIES. (3-0) Cr. 3. S.
Prerequisite: 431. Theen.
Liberalism, Marxism, democratic socialism, fascism, and conservatism.

440. BRITISH AND COMMONWEALTH GOVERNMENTS. (3-0) Cr. 3. F.
Prerequisite: 241. Teters.
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. Theen.
Comparative study of governments of France, Germany, and Italy. Their governmental processes, political parties, electoral systems, and political problems. Comparison with the United States.

442. GOVERNMENTS OF EASTERN ASIA. (3-0) Cr. 3. W.
Prerequisite: 241. Teters.
Comparative examination of the governments of China, Japan, India, Southeast Asia, their governmental processes, political parties, electoral systems, political problems. Comparison with Western government.

443. LATIN AMERICAN GOVERNMENTS. (3-0) Cr. 3. S.
Prerequisite: 241. Hadwiger.
Political processes, political institutions and problems of the Latin American republics.

444. GOVERNMENT AND POLITICS OF THE SOVIET UNION. (3-0) Cr. 3. W.
Prerequisite: 241. Theen.
Analysis of Russian political tradition, organization and functioning of the Communist Party and its role in development of the Soviet Union. Governmental structure and processes of the Soviet political system.

Prerequisite: Government 241 or 340. Palmer.
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: Government 241. Palmer.
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: History 370. Teters.
Analysis of factors shaping objectives and politics of major Asian countries as participants in world politics.

464. POLITICAL PARTIES. (3-0) Cr. 3. F.
Prerequisite: 305. Hadwiger.
Origin and development; relation to democratic process, membership and organization; nominations and elections; persistence of spoil system; campaign strategy, party finance, machine and bosses; party realignment.

466. PUBLIC OPINION AND PRESSURE POLITICS. (3-0) Cr. 3. W.
Prerequisite: 305. Hadwiger.
Nature of public opinion in a democracy; relationship of public opinion and public interest; various agencies and pressure groups influencing public opinion; their effect upon governmental policies and governmental personnel; importance of political education.

471. PUBLIC ADMINISTRATION. (3-0) Cr. 3. F.
Prerequisite: 305. Wessel.
Analysis of the operations of the executive branch of government. Problems of organizing that branch to achieve maximum efficiency.

472. GOVERNMENT AND INDUSTRY. (3-0) Cr. 3. S.
Prerequisite: 215; 305 recommended. Wessel.
Theories of constitutional protection; governmental assistance to business and agriculture; government and labor; corrective legislation in corporate organization; unfair practices; securities issues; business and taxation; bankruptcy; business with a public interest.

473. GOVERNMENT AND AGRICULTURE. (3-0) Cr. 3. F.
Prerequisite: 215; 305 recommended. Talbot.
Agriculture as a major interest in American life; tasks of government as umpire of conflicts among pressure groups; organization and operation of governmental administrative agencies serving agriculture, examination of court decisions involving agriculture, analysis of farm programs.

474. GOVERNMENT AND CONSERVATION POLICIES. (3-0) Cr. 3. W.
Prerequisite: 215; 305 recommended. Talbot.
The political process in the area of public and private land, forest, water and recreation policies. National legislative, executive and administrative processes as they apply to federal grant-in-aid programs. State policies.

495. SPECIAL PROBLEMS. Cr. 2 to 5. F.W.S. Staff.
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. GOVERNMENTS OF STATES AND METROPOLITAN AREAS. (3-0) Cr. 3. F. Wiggins.
Prerequisite: 310.

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.

520. PUBLIC LAW AND PUBLIC POLICY. (3-0) Cr. 3. S.
Prerequisite: 420. Boles.
526. DEVELOPMENT OF THE UNITED STATES CONSTITUTION TO 1865.
(Hist. 526) See History.

527. DEVELOPMENT OF THE UNITED STATES CONSTITUTION SINCE 1865.
(Hist. 527) See History.

530. ADVANCED POLITICAL THOUGHT.
(3-0) Cr. 3. S.
Prerequisite: 6 hours from 430-431-432; 532 recommended.
Intensive study of one or more of the traditional political philosophers.

531. RESEARCH METHODS IN POLITICAL SCIENCE.
(3-0) Cr. 3. F.
Prerequisite: 9 hours in government in courses above the 200 level.
Research procedures and methods in the various fields of political science. Quantitative and qualitative techniques. Use of basic research tools available to the political scientist.

532. BEHAVIORAL POLITICAL THEORY.
(3-0) Cr. 3. W.
Prerequisite: 531.
Evaluation of contemporary theory and research in voting behavior, public opinion, political values and attitudes, group participation and group action, political leadership, jurimetrics.

542. JAPANESE POLITICAL THOUGHT AND INSTITUTIONS.
(3-0) Cr. 3. Alt. S. offered 1968. Teters. Prerequisite: Hist. 370; Govt. 442.

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.

554. FOREIGN RELATIONS OF THE UNITED STATES, 1775-1898.
(Hist. 554) See History.

555. UNITED STATES AS A WORLD POWER SINCE 1898.
(Hist. 555) See History.

556. SOVIET FOREIGN POLICY.
(3-0) Cr. 3. S. Theen.
Prerequisite: Government 444, or 9 credits in government and history.
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 1968. Palmer.

560. LEGISLATIVE BEHAVIOR.
(3-0) Cr. 3. S.
Prerequisite: Govt. 360 or 464. Hadwiger. Principles, procedures, and problems of the legislative process. Structure and organization of state legislatures and the United States Congress.

561. THE CHIEF EXECUTIVE.
(3-0) Cr. 3. W.
Prerequisite: 9 hours of courses in American Government. Hadwiger. Legal and political forces influencing the U. S. President, governors and other governmental executives in decision making, developing and administering programs of government, leading public opinion and influencing legislation.

563. CONTEMPORARY ISSUES IN AGRICULTURAL POLICY
(Econ. 563) See Economics.

570. SOCIAL ORDER AND SOCIAL CONFLICT.
(Soc. 570) See Sociology.

571. THE ADMINISTRATIVE PROCESS.
(5-0) Cr. 3. W.
Prerequisite: 471. Wessel.
An analysis of classic and current administrative theory, with applications to the budgetary process.

572. PUBLIC POLICY AND SCIENCE.
(3-0) Cr. 3. W.
Prerequisite: 360, or 3 credits in 470 series. Talbot. Public program in the areas of research and development such as those of the Department of Defense, HEW, Agriculture and Interior, as well as AEC, NASA, and the NSF. Impact of such programs upon our federal system, and the universities.

590. SPECIAL TOPICS.
Cr. 2 to 5 each time taken. F.W.S.
Prerequisite: 15 credits in government. Staff approval.
B. Public Law. Boles.
C. Political Theory and Political Behavior. Talbot.
E. International Relations and American Foreign Policy. Palmer, Smith, Tetters, Theen.
F. Political Parties and Policy Formation. Hadwiger.
G. Public Policy and Public Administration. Talbot.

695. RESEARCH IN GOVERNMENT.
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.

260. INTRODUCTION TO PHILOSOPHY. (4-0) Cr. 4. 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.

321. THE OLD TESTAMENT. (3-0) Cr. 3. F.W. Shideler.
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. Shideler.
The development of Christian thought and organization to the close of the New Testament period.

331. INTRODUCTORY ETHICS. (3-0) Cr. 3. F.
Historical and critical introduction to principal ethical systems. Concepts of the nature of good, right and duty. Standards of public and private action.

350. INTRODUCTORY LOGIC. (3-0) Cr. 3. F.W.S.
The nature of critical thinking including the function of language, deductive and scientific methods.

365. INTRODUCTION TO EXISTENTIALISM. (3-0) Cr. 3. W. Vanlleen.
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 calculi as well as intuitive set theory. Some applications to philosophy and the foundations of mathematics.

430. AESTHETICS. (4-0) Cr. 4. S.
Prerequisite: 260 or basic courses in either art, music, or literature; permission of the instructor. Hartman.
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: 331.
Various ethical systems and the problems of right conduct. Discussion on the problem of moral choice in contemporary American life.

441. ANCIENT AND MEDIEVAL PHILOSOPHY. (4-0) Cr. 4. F.
Prerequisite: 260. Hartman.
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.

442. MODERN PHILOSOPHY. (4-0) Cr. 4. W.
Prerequisite: 260. Hartman.
The historical development of philosophical thought from the Renaissance through the eighteenth century. Readings from Bacon, Hobbes, Descartes, Spinoza, Leibnitz, Locke, Berkeley, Hume and Kant.

443. RECENT AND CONTEMPORARY PHILOSOPHY. (4-0) Cr. 4. S.
Prerequisite: 442. Hartman.
Philosophical developments in the nineteenth and twentieth centuries. Principal movements in idealism, realism, pragmatism, positivism, existentialism and logical analysis.

455. CHRISTIAN THOUGHT. (4-0) Cr. 4. W.
Prerequisite: 260 or 322. Shideler.
Historical development of Christian philosophy and theology; significant issues in the formulation of the creeds, the continental and English reformations, the Counter Reformation, the modern secularist attacks upon religion. Distinctive features of Roman Catholicism, Eastern Orthodoxy, Protestantism. Emphasis upon the interaction between Christian thought and secular, cultural and philosophic movements to show significance and influence of Christianity in the formation of Western culture and philosophy.

456. ORIENTAL RELIGIOUS PHILOSOPHY. (4-0) Cr. 4. F.S.
Prerequisite: 260 or 321 or 322. Shideler.
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: 260 or 321 or 322. Shideler.
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. F.S. Shideler.
Prerequisites: 260 and either 455 or 457.
Selected theologians, and theological issues in contemporary Christianity, both Protestant and Roman Catholic.
460. **CONTINENTAL RATIONALISM.**
(3-0) Cr. 3. W.
Prerequisite: 441 or 442. Van Iten.
Critical exposition of seventeenth century rationalism as developed by Descartes, Spinoza and Leibniz.

461. **THE EMPIRICIST TRADITION.**
(3-0) Cr. 3. S.
Prerequisite: 441 or 442. Van Iten.
Critical exposition of British empiricism as developed by Locke, Berkeley and Hume.

462. **EPISTEMOLOGY AND METAPHYSICS.**
(3-0) Cr. 3. F.
Prerequisite: 441 or 442 or 443. Van Iten.
Some central problems in epistemology and metaphysics. Concepts, meaning, truth, logical and causal necessity, substance, mind and space and time, determinism and freedom.

470. **INTERMEDIATE SYMBOLIC LOGIC.**
(Math. 470) (3-0) Cr. 3. F. Lehman.
Prerequisite: 370, permission of instructor.
Introduction to formal systems and recursive function theory. Church's undecidability results for formal systems. Extensions and generalizations of Goedel's results.

471. **ADVANCED SYMBOLIC LOGIC.**
(3-0) Cr. 3. W.
Prerequisite: 470.
Introduction to formal systems and recursive function theory. Church's undecidability results for formal systems. Extensions and generalizations of Goedel's results.

480. **PHILOSOPHY OF SCIENCE.**
(3-0) Cr. 3. F. Lehman.
Prerequisite: 260 or 350.
Central problems in the philosophy of science; determinism and chance in physics, geometry and relativity, various views of the meaning of probability statements; counterfactual conditionals.

481. **ADVANCED PHILOSOPHY OF SCIENCE.**
(3-0) Cr. 3. W. Lehman.
Specific topics in the philosophy of science; space and time; operationalism, the role of formalisms in scientific theories.

495. **SPECIAL PROBLEMS.**
Cr. 2 to 5 each time elected.
Prerequisite: Permission of instructor. Staff. Reading course in special topics to meet the individual needs of advanced students.

**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., 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

**COURSES PRIMARILY FOR UNDERGRADUATE STUDENTS**

105. **ORIENTATION TO HOME ECONOMICS.**
(1-0) Cr. 1. F.W.SSI.
History and future directions of home economics; planning a college program.

106. **CAREERS IN HOME ECONOMICS.**
(1-0) Cr. R.S.
Prerequisite: 105.
Professional responsibility of young home economists. Scope of home economics.

150, 250, 350, 450. **COOPERATIVE WORK-STUDY PROGRAM.**
Cr. Arr. F.W.S.

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.

400. **PROFESSIONAL RELATIONS.**
Cr. R. F.W.

420. **SENIOR SEMINAR.**
(1-0) Cr. 1. S.
A. Home Economics for General Education.
B. Home Economics Journalism.

440. **INTERDEPARTMENTAL SEMINAR.**
Cr. 1 to 4. F.W.S.
A. Issues.
B. Field Trip.
C. International.
D. Sophomore.
H. Honors.

490. **SPECIAL PROBLEMS.**
Cr. arr. F.W.S.

540. **INTERDEPARTMENTAL SEMINAR.**
Cr. arr. F.W.S.

590. **SPECIAL TOPICS.**
Cr. arr. F.W.S.
Description of Courses

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.


Opportunities for 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 University Committee on Teacher Education 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 Teacher Education.

Vocational Education Qualifications

The Department of Home Economics Education is approved by the State Board for Vocational Education for the preparation of teachers of homemaking 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. Agricultural Education 466 and 467 should be included. In addition electives should be considered in consultation with the State Leader for Home Economics Programs, the Coordinator of Extension Personnel Training or District Program Leaders for Home Economics. See also Extension Services.

Summer employment as assistants to County Extension personnel provides valuable experience for potential Extension workers. It should be considered between the Junior and Senior years.

Opportunities for 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.

The foreign language requirement for the degree Master of Science may be waived upon recommendation of the department head. German, French, Russian or Spanish may be used to meet the language requirement for the degree Doctor of Philosophy. See Graduate College.
COURSES PRIMARILY FOR UNDERGRADUATE STUDENTS

406. OBSERVATION AND METHODS OF TEACHING HOME ECONOMICS.
(3-3) Cr. 4. F.W.S.
Prerequisite: Ed. 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.

407. SUPERVISED TEACHING IN HOME ECONOMICS.
Cr. 9. F.W.S.

408. METHODS IN ADULT HOMEMAKING EDUCATION.
(2-2) Cr. 3. W.S.SSI.
Prerequisite: Credit or classification in 407. Organization of material, selection, use and evaluation of teaching techniques suited to group work with adults and to media of informal education in homemaking. Observation of adult classes. Participation in organizing and teaching adult groups.

409. PLANNING AND EVALUATING THE HOMEMAKING PROGRAM.
(3-0) Cr. 3. W.S.SSI.
Prerequisite: 407. Plans for secondary school homemaking programs for adolescents of varied ages and capabilities. Special emphasis on curriculum, evaluation and future homemakers of America. Professional ethics and organizations. Appropriate educational resources and materials.

415. PRINCIPLES OF EDUCATION FOR DIETITIANS.
(2-0) Cr. 2. F.

490. SPECIAL PROBLEMS.
Cr. arr. F.W.S.SSI, SSI.

COURSES PRIMARILY FOR GRADUATE STUDENTS, major or minor, open to qualified undergraduates

505. WORKSHOP.
Cr. 1 to 5. SS.
Prerequisite: Permission of instructor. Concentrated group study of problems in fields of home economics education indicated in sections A to E. Sections offered will vary from year to year.
A Adult Education Beavers
B Evaluation Chadderton
C Home Economics Curriculum Kohlmann
D Supervision and Administration Hill
E Special

507. Trends in Teaching Home Economics
(2-0 or 3-0) Cr. 2 or 3 SS
Prerequisite: Teaching experience. Staff.

COURSES FOR GRADUATE STUDENTS, major or minor

506. HOME ECONOMICS CURRICULA
(3-0) Cr. 3. F.SSI.
Prerequisite: 15 credits in Ed. and teaching experience or permission of instructor. Kohlmann. Bases and techniques of curriculum building applied particularly in home economics for secondary schools and colleges.

509. SPECIAL TOPICS.
Cr. arr. F.W.S.SSI, SSI.
Prerequisite: 406.
A Adult Education Beavers
B Administration
C Curriculum Hill and Kohlmann
D Evaluation Chadderton
E Extension Beavers
F Supervision Hill
G General

511. DESIGN AND PHILOSOPHY OF RESEARCH IN HOME ECONOMICS EDUCATION.
(3-0) Cr. 3. F.SSI.
Prerequisite: Credit or classification in Ed. 552 or Stat. 401. Scruggs. Application of logic and the scientific method to problems in home economics education.

610. SEMINAR.
Cr. 1 each quarter. F.W.S.SSI, SSI.

611. HOME ECONOMICS CURRICULA
(3-0) Cr. 3. F.SSI.
Prerequisite: Credit or classification in Ed. 552 or Stat. 401. Scruggs. Application of logic and the scientific method to problems in home economics education.
Description of Courses

612. EVALUATION IN HOME ECONOMICS.
(3-0) Cr. 3. W.S.
Prerequisite: 12 credits in Ed. or permission of instructor. Chadderdon.
Selection and construction of evaluation devices. Their use and interpretation in home economics programs.

614. RESEARCH.
F.W.S.SSI.SSI.
Beavers, Chadderdon, Hill, Kohlmann, Scurggs.

HOME MANAGEMENT
Margaret I. Liston, Ph.D., Head of Department

Professor: Marie A. Budolfson, M.S.
Instructors: Edith Hewitt, B.S.; Jeannette Korslund, M.S.; Nancy Larson, B.S.

Opportunities for Undergraduate Study

Home management is concerned with achievement of goals by individuals and families through thoughtful use of time, money, property, information, human resources and community facilities. Concepts and principles from several social sciences are used for description and analysis of decision-making involved in achieving standards of living.

A student who is interested in developing a program with emphasis on home management or consumer economics may do so as a major in home economics for general education. Such programs prepare for employment in Home Economics Extension Service, social welfare, and consumer services or other business positions for which backgrounds in home management and social science are desired. Valuable preparation also may be gained for graduate study leading to college teaching and research.

Those interested in further information about employment opportunities and programs of study should consult the head of the department.

Opportunities for Graduate Study

The department offers major work for the degree Master of Science and minor credit to students with majors in other departments.

Prerequisite to major graduate work is the completion of at least 15 hours in each of the following areas: communicative arts; humanities; natural sciences; social and behavioral sciences, including at least one course each in principles of economics, psychology, and sociology; home management; other fields of home economics.

The foreign language requirement for the degree Master of Science may be waived upon recommendation of the department head.

COURSES PRIMARILY FOR UNDERGRADUATE STUDENTS

375. MANAGEMENT IN THE FAMILY.
(4-0) Cr. 4. F.W.S.S.
Prerequisite: C.D. 270, Econ. 242, junior classification.
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.

415. CONSUMER ECONOMICS.
( Econ. 415) (3-0) Cr. 3. F.W.S.
Prerequisite: Econ. 242, Psych. 101, Soc. 134.
Consumers' roles in the marketing system; market organization and its impact on consumers; consumer decision-making with respect to market goods and services; evaluation of information sources for consumer buyers; analysis of programs for consumer protection. Field trip.

475. HOME MANAGEMENT HOUSE.
Cr. 4. F.W.S.SSI.SSI.
Prerequisite: 375, F. & N. 303; less than a 17 hour schedule.
Residence for one-half quarter with actual experience in decision making, homemaking and group relationships; arranged individual and group conferences. Advance reservation with department required.
488. FAMILY FINANCE.
(Econ. 488) (3-0) Cr. 3. F.W.S.S.
Prerequisite: Econ. 242, Psych. 101, Soc. 134.
Managerial approaches to financial problems of families in contemporary society. Factors influencing decisions on acquiring and using income. Concepts and techniques related to consumer credit, savings and investment, insurance, home ownership, and estate programming.

490. SPECIAL PROBLEMS.
Cr. arr. F.W.S.S.
Prerequisite: 375, permission of Instructor.
A. Independent Study.
B. Field Experience.
C. Senior Seminar.
D. Senior Project.

COURSES PRIMARILY FOR GRADUATE STUDENTS, major or minor, open to qualified undergraduates

520. FOOD ECONOMICS.
(Econ. 520) (3-0) Cr. 3. S.S.S.
Prerequisite: 9 credits in Econ., 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 FAMILY HOUSING.
(3-0) Cr. 3. W.S.S.
Prerequisite: Econ. 242, Psych. 101, Soc. 134, Liston.
Selected managerial, legal, economic and public policy aspects of family housing.

522. MANAGEMENT OF TIME AND HUMAN RESOURCES.
(3-0) Cr. 3. F.S.S.
Prerequisite: Econ. 242, Psych. 101, Soc. 134, Liston.
Perspectives concerning time and human beings as resources in family life. Social and technical concepts and principles related to use of these resources for furthering attainment of family goals.

COURSES FOR GRADUATE STUDENTS, major or minor

614. RESEARCH.
F.W.S.S. Liston.

619. SOCIAL SCIENCE METHODS IN HOME ECONOMICS RESEARCH.
(3-0) Cr. 3. W.
Prerequisite: 15 credits in Soc. Sci., credit or classification in Stat. 401, Liston.

677. SEMINAR.
Cr. arr. F.W.S.

HORTICULTURE


Associate Professors: Griffith J. Buck, Ph.D.; Charles H. Sherwood, Ph.D.; Benjamin F. Vance, B.S.

Assistant Professors: Robert J. Bauske, Ph.D.; Donald H. Dinkel, Ph.D.; Frank H. Schulte, B.S.; Jack L. Weigle, Ph.D.

Instructor: Fredrick D. Rauch, M.S.
Opportunities for 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 seedsmen 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.

Opportunities for 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.

Open to graduate students for minor only: 446, 447, 467.

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 plant-growing under glass; nutrient solution culture of greenhouse plants.

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 Bot. 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.

244A, 244B. GARDEN FLOWERS.
(3-0) Cr. 3. A: F.S.S.; B: S.
A: Open to horticulture majors. B: Not open to horticulture majors. Description, nomenclature, classification and culture 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 1967.
Prerequisite: A: Not open to horticulture majors without permission of the instructor. B: Open only to horticulture students specializing in floriculture. Principles, mechanics and uses of flower arrangements; conditioning and preparation of floral arrangement material; exhibiting and judging of flowers and flower arrangements.

313, 314. TURFGRASS MANAGEMENT.
(Agron. 313, 314) (3-0) Cr. 3. S.F.

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; relations 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.

COURSES PRIMARILY FOR GRADUATE STUDENTS, major or minor, open to qualified undergraduates

510. SPECIAL TOPICS.
Cr. arr.
Prerequisite: A major or minor in horticulture.

511. HORTICULTURAL SCIENCE.
(3-0) Cr. 3. Alt. W. Offered 1967.
Prerequisite: 3 credits Gen., 3 credits plant physiology: Agron. 354, Stat. 201A. Welge. The physiological and genetic 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 1968.
Prerequisite: Gen. 301. Welge. A study of genetic systems and breeding techniques or methods that are of particular value to the improvement of horticultural plants.

324. GRADING AND JUDGING HORTICULTURAL PRODUCTS.
(0-4) Cr. 2 each time elected. F.W.
Open to senior students only. Grading and judging horticultural crops and products; requirements of produce inspection services; staging horticultural exhibits.

401, 402, 403. SEMINAR.
(1-0) Cr. 1 each Yr.

414. MARKETING HORTICULTURAL PRODUCTS.
(4-0) Cr. 4. W.
Prerequisite: 114. Areas of production of horticultural crops, standardization, inspection, transportation, storage, price trends, agents of distribution, market news service, foreign markets, cooperative markets.

422. ADVANCED ORCHARDING.
(2-2) Cr. 3. Alt. S. Offered 1967.
Prerequisite: 321. Propagation, planting, pruning, maintenance, physiology of growth and storage of orchard crops.

446, 447. ADVANCED FLORICULTURE.
(2-2) Cr. 3 each. 446: F.; 447: Alt. W. Offered 1967.
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. S.
Prerequisite: Bot. 310, Agron. 354. 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 1967.
Origin, identification, classification, description, and genetics of woody ornamental plants.

491. SYSTEMATIC HORTICULTURE II.
(2-2) Cr. 3. Alt. W. Offered 1968.
Origin, identification, classification, description, and genetics of conservatory plants.

492. SYSTEMATIC HORTICULTURE III.
(2-2) Cr. 3. Alt. F. Offered 1968.
Origin, identification, classification, description and genetics of vegetable crops.

493. SYSTEMATIC HORTICULTURE IV.
(2-2) Cr. 3. Alt. W. Offered 1969.
Origin, identification, classification, description and genetics of fruit crops.
COURSES FOR GRADUATE STUDENTS, major or minor

600. RESEARCH.
   A. Floriculture. Buck.
   B. Fruit Crops. Denisen.
   C. Vegetable Crops. Weigle.
   D. Nursery Crops. Mahlstede.
   E. Arboriculture. Mahlstede.
   F. Turfgrass. Roberts.

604. GRADUATE CONFERENCE.
   Cr. 1 each time elected. F.W.S. Denisen.

690. ADVANCED SYSTEMATIC HORTICULTURE I.
   (2-2) Cr. 3. Alt. F. Offered 1967.
   Prerequisite: 490 or 15 credits in advanced Hort. or Bot. Staff.
   Identification, classification, propagation, and origin of woody ornamental plants.

691. ADVANCED SYSTEMATIC HORTICULTURE II.
   (2-2) Cr. 3. Alt. W. Offered 1968.
   Prerequisite: 491 or 15 credits in advanced Hort. or Bot. Staff.
   Identification, classification, propagation, and origin of conservatory plants.

692. ADVANCED SYSTEMATIC HORTICULTURE III.
   (2-2) Cr. 3. Alt. F. Offered 1968.
   Prerequisite: 492 or 15 credits in advanced Hort. or Bot. Staff.
   Classification, origin, and genetics of vegetable crops.

693. ADVANCED SYSTEMATIC HORTICULTURE IV.
   (2-2) Cr. 3. Alt. W. Offered 1969.
   Prerequisite: 493 or 15 credits in advanced Hort. or Bot. Staff.
   Classification, description and nomenclature of temperate and sub-tropical fruits.

HOUSEHOLD EQUIPMENT

Elizabeth Beveridge, M.S. Head of Department

Professor: Louise J. Peet, Ph.D.
Associate Professors: Mary S. Pickett, Ph.D.; Naomi D. Shank, B.S.; Helen J. Van Zante, Ph.D.
Instructor: Virginia P. Bishop, M.S.

Opportunities for Undergraduate Study

For undergraduate curricula in household equipment and in household equipment and related science leading to the degree Bachelor of Science, see Home Economics, Curricula.

The Household Equipment Department offers courses designed to develop understanding of modern home appliances, their contribution to effective family living and certain fundamental principles of housing. Basic concepts and principles from the physical, biological and social sciences are applied, through the study of equipment, to the health, comfort and safety of the family, to the intelligent use of family resources and to performing household tasks in ways which contribute to furthering individual and family goals.

The household equipment curriculum prepares primarily for work in business positions. There are two broad types of work to which this major leads: (1) the preparation and dissemination of consumer information about equipment and physical aspects of housing and (2) research and development work. Students interested in consumer information aspects are employed by home service departments of appliance manufacturers, gas and electric utility companies and consumer magazines. Those interested in the technical aspects of equipment find their opportunities in research, testing and development departments of appliance manufacturers and in government or commercial laboratories; in these positions they work with other technical people.

The household equipment and related science curriculum leads to positions in laboratory research or development work, or to graduate study. Any student interested in graduate work should choose this curriculum or include statistics and additional mathematics in the regular household equipment curriculum.

Household equipment provides a broad base for work in Home Economics Extension. See Curricula in Home Economics. Students preparing for Extension work through other curricula or those preparing for such professions as teaching or television will find 254, 308, 318, 407, 408, 409, and 421 valuable. For emphasis in housing, 254, 308, 318, 445 and 446 are suggested.
Opportunities for 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 certain departments offering work for this degree in home economics, physical or social sciences or engineering. The department cooperates in the Water Resources Program. See Water Resources.

Prerequisite to major graduate work is the completion of basic course work in household equipment and food preparation and a fundamental knowledge of chemistry, physics and mathematics. It is recommended that a student have a background in home economics but training in physical, chemical or biological sciences may be suitable. Basic courses considered as prerequisites may be taken during the first year of graduate study but without graduate credit.

The exact requirements for an advanced degree will depend upon the field of work the student wishes to pursue and are subject to approval by the student's advisory committee.

Open to graduate students for minor only: 404, 421, 445, 446, 490.

COURSES PRIMARILY FOR UNDERGRADUATE STUDENTS

254. **BASIC PHYSICAL PRINCIPLES.**

(3-0) Cr. 3. F.W.S.SSI.
Prerequisite: 1 unit high school physics, or high school chemistry, or Phys. 106 or Chem. 105.
Application of basic principles of heat, light, mechanics to home equipment; fundamentals of electricity, gas and water for the home; use and care of materials in the house and its equipment.

308. **HOME LIGHTING AND KITCHEN PLANNING.**

(2-6) Cr. 4. F.W.
Prerequisite: 254.
Factors affecting efficiency of light sources; lighting design for the home. Planning of kitchens and work areas for convenience, comfort and contribution to family living; problems of installation and remodeling.

318. **SMALL EQUIPMENT.**

(2-4) Cr. 3. F.W.S.SSI.
Prerequisite: 254.
Electric and non-electric appliances for food preparation, dishwashing, food disposal, care and maintenance of the home, construction and care of clothing.

400. **SENIOR OBSERVATION TRIP.**

Cr. R. Alt. Yrs. Offered 1967-68.
Prerequisite: Junior classification.
Observation in manufacturing plants, testing laboratories, home service departments, and lighting institutes.

404. **EQUIPMENT TECHNOLOGY.**

(3-3) Cr. 4. F.
Prerequisite: Credit or classification in 254.
Advanced study of electricity and gas as applied to appliances; safety in use of fuel gas and electricity, use of laboratory instruments for determining operating characteristics of appliances, house wiring.

407. **GAS AND ELECTRIC RANGES.**

(2-4) Cr. 3. W.
Prerequisite: 254. F. & N. 208.
Range fuels, range parts and principles of operation. Standard tests. Surface, oven and broiler cookery. New developments in controls and special features; electronic range.

408. **HOME LAUNDERING TECHNOLOGY.**

(2-6) Cr. 4. S.
Prerequisite: 254. T. & C. 104.
Principles of home laundering. Study and use of equipment important to effective laundering.

409. **HOME REFRIGERATION.**

(2-4) Cr. 3. F.
Prerequisite: 254 and Bact. 200 or equivalent.
Physical principles of heat as applied to refrigeration; operating characteristics, use and management of refrigerators and freezers.

415. **HOUSEHOLD EQUIPMENT FIELD WORK.**

Cr. 3. Arr.
Prerequisite: Junior classification, permission of department head.
Professional work in household equipment or industry. Special report required.

421. **TRAINING IN DEMONSTRATION TECHNIQUES.**

(2-4) Cr. 3. F.W.
Prerequisite: 254, Sp. 211, credit or classification in F. & N. 303, junior classification.
Experience in planning and presenting direct audience demonstration. Techniques for presentation before various size groups. Reservation required.

422. **PROFESSIONAL ORIENTATION.**

(3-0) Cr. 3. W.
Prerequisite: Junior classification in H.Eq.
Opportunities for professional work in household equipment; the home economist in the business organization; human and public relations; professional responsibilities and ethics; personal growth and social responsibility.

425. **SEMINAR.**

(2-0) Cr. 2. S.
Prerequisite: Senior classification.

445. **HOUSE UTILITIES.**

(3-2) Cr. 3. S.SSI.
Prerequisite: 254, junior classification.
Basic principles related to comfort, health and safety in plumbing, home heating and cooling; home communication systems.
446. **HOUSE EVALUATION.**
(3-2) Cr. 3. F.
Prerequisite: 254.
A course emphasizing important points in house selection. Special attention is given to the structural quality, safety, comfort and convenience of new houses and older houses.

490. **SPECIAL PROBLEMS.**
Cr. arr. F.W.S.
Prerequisite: 12 credits in H.Eq., permission of department head.
A. Laundry.
B. Housing
C. Foods Related Equipment.
D. House Care and Maintenance Equipment
E. Residential Lighting

**COURSES PRIMARILY FOR GRADUATE STUDENTS, major or minor, open to qualified undergraduates**

505. **RESEARCH METHODS IN HOUSEHOLD EQUIPMENT.**
(2-4) Cr. 3. W.
Prerequisite: 304. Van Zante.
Research methods and techniques, instrumentation, data analysis

590. **SPECIAL TOPICS.**
Cr. arr. F.W.S.
Prerequisite: 505 or concurrent registration; permission of department head. Beveridge, Pickett, Van Zante.
A series of non-sequence courses in which graduate students do individual investigations relating to different areas of the equipment and housing fields.
A. Gas and Electric Ranges
B. Refrigeration.
C. Lighting.
D. Laundering Equipment.
E. Small Equipment.
F. Advanced Laboratory.
G. Housing

**COURSES FOR GRADUATE STUDENTS, major or minor**

604. **SEMINAR.**
(1-0) Cr. 1. S. Beveridge, Pickett, Van Zante.

605. **ADVANCED EQUIPMENT TECHNOLOGY.**
Cr. arr. Offered on demand.
Prerequisite: 505. Van Zante.
Applications of principles of heat and light and associated research techniques.

690. **RESEARCH.**
Beveridge, Pickett, Van Zante.
HYGIENE

Gail McClure Proffitt, M.D., Head of Department

Professor: John G. Grant, M.D.
Assistant Professors: C. Raymond Bickerstaff, M.Ed., Cecil V. Hamilton, M.D.

Opportunities for 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.

INDUSTRIAL ADMINISTRATION

William H. Schrampfer, J.D., Head of Department

Associate Professor: Bruce T. Kruse, Ph.D.

Opportunities for 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 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 presents the opportunity of 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.
Description of Courses

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.

Students who wish to specialize in the study of international affairs may do so through the International Service programs while majoring in industrial administration. See International Service Programs for additional information regarding this program.

COURSES PRIMARILY FOR UNDERGRADUATE STUDENTS

150. INTRODUCTION TO INDUSTRIAL ADMINISTRATION.
(4-0) Cr. 4. F.W.S.S.S.S.
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.S.
Prerequisite: Econ 242.
Marketing functions, institutions and policies as applied to the industrial market.

350. BUSINESS FINANCE.
(3-0) Cr. 3. F.S.S.
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.
(Arch. 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, economic 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.
Prerequisite: Econ. 242.
Historical development and current role of transportation in the United States 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.
D: For students in business administration.
Fundamental principles of law as applied to business transactions and business relationships. Affords the student 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.
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: 3 credits in Principles of Economics.
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.

*372. GENERAL ACCOUNTING.
Cr. 4. A: (2-3) S.S.S.S.S.II; B: (4-0) F.W.; C: (3-2) F.
C: For students in dairy and food industries. Emphasis upon accounting applications to food and dairy enterprises.

*384. ACCOUNTING I.
(2-4) Cr. 4. F.W.S.S.S.S.II.
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.S.S.II.
Prerequisite: 384 or 372, 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.S.S.II.
Prerequisite: 385.
Accounting functions and introduction to accounting theory; application of valuation principles; interpretation of financial statements.

425. INCOME TAX PROCEDURES.
(3-0) Cr. 3. F.W.S.S.
Prerequisite: One course in accounting.
Survey of income tax problems with emphasis upon transaction planning and return preparation for individuals.
440. INDUSTRIAL MARKETING II. (3-0) Cr. 3. F.
Praerequisite: 340.
Extension of 340 with emphasis upon procurement in the industrial market; application of principles to selected cases.

443. MARKETING MANAGEMENT. (3-0) Cr. 3. S.
Praerequisite: 340.
Formulation of marketing policies; administration of market operations; application of principles to representative problems of selecting, training, organizing and managing personnel. Field trip.

445. INVESTMENTS. (4-0) Cr. 4. F.W.SS.
Praerequisite: Econ. 242, I.Ad. 350, 384 recommended.
Security prices and yields; essential investment features of various corporate securities—risk, income, control; methods of testing bonds and stocks; individual investment programs.

461. BUSINESS LOGISTICS. (4-0) Cr. 4. F.W.S.
Physical supply and physical distribution in industrial or commercial operations. Coordination of such business logistics activities as order processing, supply scheduling, inventory management, warehouse operation and transportation and traffic.

463. HIGHWAY TRANSPORTATION. (3-0) Cr. 3. W.
Praerequisite: Econ. 242.
Types and character of the present commercial highway services. Appraisal of the competitive relationships between the different classes of service and other agencies of transportation. Current problems in the administration and financing of the national highway system.

465. TRAFFIC MANAGEMENT. (4-0) Cr. 4. W.S.
Praerequisite: 360.
Organization, functions and duties of the traffic management departments in small and large industries. Shipper-carrier relationships; shipping procedures; selection of transportation media; freight classification; freight rate tariffs. Economic implications of transit privileges, routing, warehousing and demurrage. Includes transportation by rail, motor, air, water, pipeline, express and parcel post. Field trips to industrial and carrier installations.

467. PUBLIC UTILITIES. (3-0) Cr. 3. F.
Praerequisite: 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.
Praerequisite: 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.
Praerequisite: 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.
Praerequisite: 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.
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.SS.
Praerequisite: 372A or 384; or 372C.
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.
Praerequisite: 386, 480.
Development of standard production cost systems, including typical managerial reports. Study of distribution costs, manufacturing budgets, incremental cost and profit/volume analysis. Introduction to direct costing. Field trips.

486. INDUSTRIAL MARKET ANALYSIS. (3-0) Cr. 3. W.
Praerequisite: 340.
Development of procedures and analysis techniques for a quantitative and qualitative determination of market potentials through selected projects. Field trip.

490. INDUSTRIAL RISKS. (3-0) Cr. 3. F.W.S.S.
Praerequisite: 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.
Praerequisite: 386.
Advanced accounting theory and its application; accounting systems and machine techniques; presentation of managerial importance of future planning through accounting. Field trips.

496. ADVANCED ACCOUNTING II. (3-0) Cr. 3. W.
Praerequisite: 386 (may be taken concurrently with 495).
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.
Description of Courses

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.SS1, SSII.
Prerequisite: Senior classification, permission of department head.

*Only one of the following courses may count toward graduation. 371, 372, 384.

INDUSTRIAL EDUCATION

For description of courses, see Education

INDUSTRIAL ENGINEERING

Joseph K. Walkup, B.M.E., I.E., Head of Department

Professors: Harold A. Cowles, Ph.D.; Jean C. Hempstead, C.E., M.A.; Arthur C. Klein­
schmidt, Ph.D.; James P. McKean, M.S., L.L.B.; Richard Squires, M.S.

Associate Professors: Daniel L. Griffen, Jr., M.S., J.D.; Clifford E. Smith, Ph.D.; Gerald W. Smith, Ph.D.; Victor M. Tamashunas, M.S.; Richard C. Vaughn, M.I.E.

Assistant Professors: Edward J. Carney, M.S.; Robert D. Love, M.S.; Keith L. McRoberts, Ph.D.; Loran E. Mohr, M.S.; Franklin K. Wolf, M.S.

Instructors: Herbert A. Harmison, Jr., B.S.; Harold M. Hoover, Jr., B.S.; Christopher J. Joannides, B.S.; George E. Lamp, M.S.

Opportunities for 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

Opportunities for 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 only: 312, 361, 404, 407, 415, 416, 421, 422, 425, 426, 441, 442, 443, 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, credit or classification in Math. 102. 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: Math. 102. Training in skills, standards and methods essential for engineering computations.

109. INTRODUCTION TO DIGITAL COMPUTERS. (1-1 or 0-3) Cr. 1. F.W.
Prerequisite: 3 credits of mathematics, engineering students required to have credit in 105 or 108. Elementary programming techniques including the use of interpretive routines fundamentals in and appreciation of high-speed electronic digital computers including laboratory exercises on the computing center equipment.

250. INTRODUCTION TO INDUSTRIAL ENGINEERING. (4-0) Cr. 4. 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, memorization and random filming techniques. Consideration of human factors and economic factors in methods engineering and work-center design, work-simplification and production system development. Introduction to standard data and predetermined standard times.

293. SEMINAR. (1-0) Cr. R. F.W.S.
Required of all third-quarter sophomore students. Required of senior college transfer students in the first quarter after transfer to the Industrial Engineering Department. May be taken concurrently with 391.

304. ANALYSIS FOR ENGINEERING ECONOMY. (3-0) Cr. 3. F.W.S.
Derivation of formulas used in theory of investment of engineering enterprises, economy studies applied to original and alternative investments in engineering, replacement problems, relationship to accounting.

312. INTRODUCTION TO MANAGEMENT SCIENCE. (5-0) Cr. 5. W.S.
Prerequisite: 250. Math. 304; credit or classification in Math. 213. Mathematical concepts and models related to the analysis and synthesis of systems associated with management of industrial organizations. Single and multi-variate optimization models; linear and non-linear systems. Interpretation of these models and systems in physical terms.

351. INDUSTRIAL ORGANIZATION. (3-0) Cr. 3. F.W.S.
Prerequisite: Junior classification. Industrial tendencies, ownership, types of organization; the principles and methods of production control, inspection, motion and time study, wage systems, cost control and personnel relations in the coordination of an industrial organization.

361. QUANTITATIVE METHODS FOR INDUSTRIAL ENGINEERING. (3-0) Cr. 3. F.W.
Prerequisites: 250; 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 I.E. 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, I. Ad. 371. Application of fundamentals of economics to engineering alternatives in planning, developing and managing industrial projects.
407. ENGINEERING VALUATION. (3-0) Cr. 3. F.W.S.
Prerequisite: Econ. 241, 3 credits of accounting.
Concepts of value, original cost, and reproduction cost, property records, methods of estimating depreciation for valuation and accounting; intangible values, cost values, earning values, rate base, and valuation for taxation, rates, financing, insurance and sales.

415. INDUSTRIAL OPERATIONS RESEARCH. (3-0) Cr. 3. W.S.
Prerequisite: 312, 361.
History and growth of operations research in industry. Applications of methods and techniques to industrial situations.

416. PRODUCTION ANALYSIS. (3-0) Cr. 3. S.
Prerequisite: 415.
Specialized mathematical techniques applied to industrial production management.

421. SAFETY ENGINEERING. (3-0) Cr. 3. F.S.
Prerequisite: 250 or 351.

422. JOB EVALUATION. (2-3) Cr. 3. Alt. S. Offered 1968.
Prerequisite: 273 or 475.
Determining requirements of jobs, analysis for degree and extent of major job factors, weighing of factors, development of basic hourly rate curves, salary classifications, administrative procedures. Practice in description and evaluation.

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.
Problems relating to personnel management, stressing organization and universally significant managerial functions, procedures and relationships.

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 rates, the taxation, and the operation of public utilities.

507. DEPRECIATION ESTIMATES.
(3-0) Cr. 3. W.S.
Prerequisite: 407.
Collection and analysis of retirement data. Techniques required for the construction of survivor, probable life, condition percent, and accrued depreciation curves for property groups. Analysis of the effect of growing, declining and stable properties on depreciation estimates.

509. ENGINEERING VALUATION PRACTICE.
(2-3) Cr. 3. F.S.
Prerequisite: 407.
Application of principles of engineering valuation including field work, preparation and pricing of inventories, valuations for utility rates, security regulations, condemnations, sales, estate settlements, and for determining fixed capital costs.

515. MANAGEMENT SCIENCE I.
(3-0) Cr. 3. W.
Prerequisite: 415.
Development of scientific models and analogies applicable to engineering management; investigation of existing mathematical methods; operations research.

516. MANAGEMENT SCIENCE II.
(3-0) Cr. 3. S.
Prerequisite: 515.
Case studies and industrial problems. New methods and theories in management science and operations research.

522. ENGINEERING ASPECTS OF WAGE DETERMINATION.
(2-3 or 6) Cr. 3 or 4. S.
Prerequisite: 422.
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.

540. OPERATIONS RESEARCH METHODS AND ECONOMIC ANALYSIS.

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.

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. 385A.
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 ad valorem, 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.

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.
INSTITUTION MANAGEMENT

Marjorie M. McKinley, Ph.D., Head of Department

Professors: Grace M. Augustine, Ph.D., (Emeritus); Lenore M. Sullivan, M.S.

Assistant Professors: Doris J. Hittle, M.A.; Olga Madison, M.S.; Geraldine M. Montag, Ph.D.; Grace E. Olsen, M.S.; Thomas E. Walsh, M.A.

Instructors: Louise M. Mullan, M.S.; Janice C. Traynham, M.S.

Opportunities for 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 Institute, Food Service.

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 lunch 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 food service 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 for the Associate Diploma in food service management. For detailed information concerning the Technical Institute program, see Technical Institute, Food Service.

Opportunities for 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 6 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.
The foreign language requirement for the degree Master of Science may be waived upon recommendation of the department head. For the language requirement for the degree Doctor of Philosophy see Graduate College.

Open to graduate students for minor only: 484, 485, 487, 488, 489.

COURSES PRIMARILY FOR UNDERGRADUATE STUDENTS

287. INTRODUCTION TO FOOD SERVICE MANAGEMENT. (2-0) Cr. 2. W. Walsh.
Orientation to the scope of the food service industry and various aspects of management. Field trips required.

380. QUANTITY FOOD PRODUCTION MANAGEMENT. (2-6) Cr. 4. F.W.S.SSI.
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. Cr. 1. Alt. S. Offered 1968.
Prerequisite: Junior or senior I. Mgt. classification. Walsh.
Study tour of quantity food service and house administration units and of related industries.

404. SEMINAR. (2-0) Cr. 2. S.
Prerequisite: Senior classification. McKinley.

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.

COURSES PRIMARILY FOR GRADUATE STUDENTS, major or minor, open to qualified undergraduates

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, institution equipment, and proportions of ingredients.

585. CATERING. (2-6) Cr. 4. F.W. Alt. S.SI. Offered 1968.
Prerequisite: 380, senior classification.
Management, preparation, and presentation of special food service functions. Appreciation of historical and cultural background of U.S. regional and foreign foods. Creative experiences with gourmet-type foods. Advance registration with department head required.

590. SPECIAL TOPICS AND WORKSHOPS. Cr. arr. F.W.S.SSI, SSSI.
Prerequisite: Permission of department head. McKinley, Montag.
A. School Food Service Workshop.
B. Food Service Management Workshop.
C. General.

COURSES FOR GRADUATE STUDENTS, major or minor

604. SEMINAR. Cr. arr. F.W.S. McKinley.

607. INSTITUTION ADMINISTRATION. (3-0) Cr. 3. W.S.SSI.
Prerequisite: Permission of department head. Montag.
Job analysis, labor policies, labor organization, personnel problems, and financial control.

486. INSTITUTION MANAGEMENT EXPERIENCE.
A: (1-0 to 2-0) Cr. 1-2. W.
B: (0-0 to 0-9) Cr. 2-3. W.
Prerequisite: 484, 485, 488, senior classification.
A. Lecture - Discussion.
B. Laboratory.
Personnel management, cost control, and quality control in specific organizations. Experience in food and housing departments of Iowa State University, Memorial Union, and approved food services.

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.

489. HOUSE ADMINISTRATION. (2-3) Cr. 3. W.
Prerequisite: 484, senior classification.
Management procedures in residence and housekeeping departments of institutions. Selection of equipment, furnishings, linens, and supplies. Field trips required.

490. SPECIAL PROBLEMS. Cr. arr. F.W.S.SSI, SSSI.
Prerequisite: Permission of department head.
A. Quantity Food Production.
B. Organization and Management.
C. General.

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, SSSI. McKinley, Montag.
INTERNATIONAL SERVICE PROGRAMS

University International Service Programs Committee: Hang-sheng Cheng, Ph.D.; Julia M. Faltinson, M.S.; Alfred P. Kehlenbeck, Ph.D.; William Kenkel, Ph.D.; Richard Squires, M.S.; Barbara J. Teters, Ph.D.; Rolf Theen, Ph.D.; Louis M. Thompson, Ph.D.; Erik Thorbecke, Ph.D.

The international service programs are designed for students who are interested in international relations or international economics as fields 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 four colleges: Agriculture, Engineering, Home Economics, or Sciences and Humanities. Any student who wishes to enter any one of the international services programs must file an application with the dean of his college. The student and his adviser are responsible for stating on the senior requirements sheet that he is completing the program. The students completion of the program requirements must be certified to the Registrar by a member of the International Services Program Committee representing the student's college.

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>Subjects</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Modern Foreign Language</td>
<td>21</td>
</tr>
<tr>
<td>Spanish, French, German, or Russian</td>
<td></td>
</tr>
<tr>
<td>Government 351, 352</td>
<td>6</td>
</tr>
<tr>
<td>World Politics and International Organization</td>
<td></td>
</tr>
<tr>
<td>Government</td>
<td></td>
</tr>
<tr>
<td>Govt. 422 International Law</td>
<td>6</td>
</tr>
<tr>
<td>Government electives</td>
<td></td>
</tr>
<tr>
<td>Economics</td>
<td>6</td>
</tr>
<tr>
<td>Econ. 455 International Economics</td>
<td></td>
</tr>
<tr>
<td>(Econ 512 Agrarian Reform and Economic Development, recommended)</td>
<td></td>
</tr>
<tr>
<td>Sociology 218</td>
<td>3</td>
</tr>
<tr>
<td>Cultural Anthropology</td>
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<tr>
<td>World Resources</td>
<td>6</td>
</tr>
<tr>
<td>Agron. 406 Climates of the Continents</td>
<td></td>
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<tr>
<td>Agron 483 World Soil Resources</td>
<td></td>
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<tr>
<td>Geol. 321 World Geography</td>
<td></td>
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<tr>
<td>Geol. 322 Economic Geography</td>
<td></td>
</tr>
</tbody>
</table>

Total: 48

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>Subjects</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Psychology 101</td>
<td>3</td>
</tr>
<tr>
<td>General Psychology I</td>
<td></td>
</tr>
<tr>
<td>Industrial Administration 365A</td>
<td></td>
</tr>
<tr>
<td>Business Law I</td>
<td>3</td>
</tr>
<tr>
<td>Geology 100, 321, 322</td>
<td>9</td>
</tr>
<tr>
<td>Introduction to Geology</td>
<td></td>
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<tr>
<td>World Geography</td>
<td></td>
</tr>
<tr>
<td>Economic Geography</td>
<td></td>
</tr>
</tbody>
</table>

Total: 30
### International Service Programs

**Government 351, 352**
World Politics and International Organization 6

**Government 215**
American Government 3

**Government Electives, one of the following courses** 3
- 340 Politics of Developing Nations
- 440 British and Commonwealth Governments
- 442 Governments of Asia
- 443 Governments of Latin America
- 445 Politics of the Middle East
- 446A, 446B Governments of Africa
- 451 Asia in World Affairs

**Economics 241, 242, 455**
- Principles of Economics 9
- International Economics

**History Electives, one of the following courses** 3
- 357 History of England and Great Britain
- 370 The Far East in Modern Times
- 425 A, B Twentieth Century Europe
- 450 History of Modern Russia
- 461 Modern Japan
- 465 History of Latin America

**English 101, 102, 103**
- Principles of Composition 9

**Speech 211**
- Fundamentals of Speech 3

**Sociology 218**
- Cultural Anthropology 3

**Modern Foreign Language**
- Spanish, French, German or Russian or demonstrated ability 18

Total 72

Interested students in Engineering should consult Richard Squires for further details.

### 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, government, 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. Faltinsson for further details.

### International Service Program in the College of Sciences and Humanities:

Students in the international service program in the College of Sciences and Humanities are required to fulfill the group requirements of the College. They must major in one of four fields: economics, government, history, foreign languages or sociology. They are required to select their minors from two of the following fields: economics, government, history, industrial administration, foreign languages, philosophy, sociology. In exceptional cases, with permission of the International Service Programs Committee, a student may substitute a different field for one of the minors. In completing his major, minors, and group requirements, each student in the international service program in the College of Sciences and Humanities must take the following courses:
Description of Courses

Economics
- 241, 242 Principles of Economics
- 304 Money and Banking
- 306 Comparative Economic Systems
- 455 International Economics

Credits: 15

English
- 201 Introduction to Literature
- 354 World Literature

Credits: 6

Geology
- Two of the following courses
  - 221, 222 Cultural Geography
  - 321 World Geography
  - 322 Economic Geography

Credits: 6

Government
- Five of the following courses
  - 340 Politics of Developing Nations
  - 351, 352, 353 World Politics and International Organization
  - 422 International Law
  - 432 Development of Political Thought 19th and 20th Centuries
  - 440 British and Commonwealth Governments
  - 441 Governments of Western Europe
  - 442 Governments of Asia
  - 443 Governments of Latin America
  - 444 Governments and Politics of the Soviet Union
  - 445 Politics of the Middle East
  - 446A, 446B Governments of Africa
  - 451 Asia in World Affairs

Credits: 15

History
- Four courses including at least one from each group
  - Group A
    - 357 History of England and Great Britain
    - 425 A, B Twentieth Century Europe
    - 450 History of Modern Russia
  - Group B
    - 369 History of the Far East to 1600
    - 370 The Far East in Modern Times
    - 461 Modern Japan
    - 465 History of Latin America
    - 466A, 466B Governments of Africa

Credits: 12

Industrial Administration
- 460 Principles of Transportation

Credits: 3

Foreign Languages
- Spanish, French, German or Russian

Credits: 27

Sociology
- Two of the following courses
  - 218 Introduction to Anthropology
  - 321 Primitive Cultures of the World
  - 424 Ethnology of the Old World
  - 425 Intercultural Relations

Credits: 6

In addition, to complete major and minors, he should select his courses from those most directly related to international relations and international trade. For additional details on requirements and opportunities in international service, students should consult their advisers and the chairman of the International Service Programs Committee.

LANDSCAPE ARCHITECTURE

Thomas A. Barton, M.L.A., Head of Department


Associate Professor: Margherita Tarr, B.S.

Opportunities for 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 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 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.

Opportunities for Graduate Study

The department offers major work for the degree Master of Landscape Architecture and minor work to students taking major work in other departments. The degree Master of Landscape Architecture is granted upon the completion of satisfactory resident graduate work and the acceptance of a thesis or a terminal project.

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.

Open to graduate students for minor only: 334, 335, 336, 404, 411, 412, 413, 466.

COURSES PRIMARILY FOR UNDERGRADUATE STUDENTS

110. ORIENTATION IN LANDSCAPE ARCHITECTURE. (1-0) Cr. R. F.
Survey of landscape architecture and allied fields

112. LANDSCAPE ARCHITECTURE DRAWING. (0-6) Cr. 2. W.S.
Introduction to landscape architecture and the conventional drawing practices and methods of delineation, including freehand sketching, lettering, instrumental and perspective drawing and presentation.

113. LANDSCAPE PERCEPTION. (1-6) Cr. 3. S.SSI.
Prerequisite: 112.
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, 202. HISTORY OF LANDSCAPE ARCHITECTURE. (3-0) Cr. 3. each. F.W.
The development of landscape architecture from antiquity to modern times, with its relation to and influences of allied arts and professions. Lectures, readings, abstracts and reports.

210. ELEMENTS OF LANDSCAPE ARCHITECTURE. (3-0) Cr. 3. W.SSI.
Appreciation of the landscape and those elements of which it is composed. Brief of procedures in the planning and development of private property and public areas. Field trips. Not open to students majoring in landscape architecture.

213. THEORY OF LANDSCAPE DESIGN. (2-3) Cr. 3. S.
Prerequisite: 113.
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: Bot. 101; 232: 231; 233: 232.
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.

301, 302, 303. DETAILS OF CONSTRUCTION. (1-6) Cr. 3 each. 301, S; 302, W; 303 F.
Prerequisite: C.E. 214.
Theory and drafting room problems in landscape construction including grading, drainage and utility plans, estimates of cuts, fills, and cost data.

311, 312, 313. LANDSCAPE DESIGN. (0-9) Cr. 3 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, 335, 336. PLANTING DESIGN. (1-6) Cr. 3 each. 334, F; 335, S; 336, W.
Prerequisite: 233, classification in 311.
Arrangement and use of plants in landscape and architectural design, with drafting and field practice.
Description of Courses

341, 342. TRAVEL AND PRACTICE.

404. PUBLIC RECREATIONAL FACILITIES.
(3-0) Cr. 3. F.
Principles of design, construction and operation with special emphasis on national and state parks and forests.

411, 412, 413. ADVANCED LANDSCAPE DESIGN.
(0-9) Cr. 3 each. Yr.
Prerequisite: 313.

441. PROFESSIONAL PROCEDURE.
(2-3) Cr. 3. S.
Office organization, forms, field operations, professional ethics and public relations.

466. SPECIAL PROBLEMS.
Cr. 2 to 4. F.W.S.SSI.
Prerequisite: Permission of department head and instructor.
H Honors Program.
Investigation of an approved topic of special interest to the student.

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

COURSE FOR GRADUATE STUDENTS, major or minor

600. RESEARCH.

URBAN PLANNING

Administered by the Department of Landscape Architecture.

Opportunities for 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.

Opportunities for Graduate Study

The department offers work for the degree Master of Science, major in town and regional planning. 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, and urban planning; and training in design and graphic presentation.

The following courses are open for major graduate credit to graduate students in town and regional planning: Arch. 610; C.E. 553, 656, 690; Econ. 510, 556, 576, 630, 698E, 699B; Govt. 510; L.A. 600; Soc. 570, 575, 596, 610, 664, 699B; U.P. 510, 530, 550D, 550E, 550F, 550G, 550H, 561, 562, 571, 620.

Open to graduate students for minor only: 361, 372, 373, 383, 431, 432, 433, 456, 492.
For students interested in interdisciplinary study of housing, a program is administered in cooperation with the Departments of Applied Art, Architecture, Home Management, Household Equipment and Landscape Architecture. For details consult the head of the department.

### COURSES PRIMARILY FOR UNDERGRADUATE STUDENTS

#### 110. ORIENTATION IN URBAN PLANNING
(1-0) Cr. R. F.
Survey of urban planning and allied fields

#### 253. INTRODUCTION TO 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

#### 361. URBAN PROBLEMS AND PLANNING GOALS
(3-0) Cr. 3. F.
Prerequisite: 253 or classification in fifth year architecture.
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 of basic economic, population, and physical studies, and of projections of and timing for needed land uses and public services. Exercises in the use of sources and techniques

#### 383. THEORY OF THE PLANNING PROCESS
(3-0) Cr. 3. S.
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

### COURSES PRIMARILY FOR GRADUATE STUDENTS, major or minor, open to qualified undergraduates

#### 510. SEMINAR
(1-0) Cr. I. F.W.S.

#### 530 ADVANCED PHYSICAL PLANNING
(0-9) Cr. 3 each time elected. F.W.S.
Prerequisite: 433, 561, 571, or graduate classification in town and regional planning. (561 and 571 may be taken concurrently with 530).
Practice in advanced planning projects with emphasis on the planning of urban regions

#### 550. SPECIAL TOPICS
Cr. 2 to 5 each time elected. F.W.S.
Prerequisite: Permission of department head and instructor.
I. Urban Development Planning
II. Urban Renewal
III. Regional Planning
IV. Urban Development Programming
V. Planning Law and Administration

#### 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 and 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 for accommodating
Description of Courses

value conflicts in the planning process. Identification of value components in planning information

571. TECHNIQUES OF PHYSICAL PLANNING.
(3-0) Cr. 3 F.

COURSE FOR GRADUATE STUDENTS, major or minor

620. RESEARCH.

LIBRARY

Robert W. Orr, M.S., Head of Department

Associate Professors: John E. Galejs, M.A.L.S.; John C. McNee, A.M.L.S.; Margaret H. Orr, B.L.S.; Fred M. Peterson, M.A.; Evelyn G. Wimersberger, M.S.; Elizabeth A. Windsor, M.S.

Assistant Professor: Matyne H. Easton, B.A.


Opportunities for Undergraduate Study

Courses are designed to increase facility in the independent use of libraries and books. 106 is required of all freshman and transfer students in the following colleges without credit: Engineering and Home Economics.

116 is required of all sophomore and transfer students in the following colleges with one hour of credit: Agriculture and Sciences and Humanities.

Opportunities for 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" (Lib. 614) may be taken for either major or minor credit in any department.

COURSES PRIMARILY FOR UNDERGRADUATE STUDENTS

106. LIBRARY INSTRUCTION.
Cr. 1. 5 weeks.
For students in Home Economics. F.
For students in Engineering. W.
Use of libraries and books

116. LIBRARY INSTRUCTION.
Cr. 1. 10 weeks.
For students in Agriculture. F.
For students in Sciences and Humanities. S.
Use of libraries and books, including a survey of literature of major curricula

COURSE FOR GRADUATE STUDENTS, major or minor

614. BIBLIOGRAPHIC RESEARCH.
(1-0) Cr. 1. F.W.S.S.
Prerequisite: College degree. Orr.

lectures and practice on location of printed and manuscript materials and preparation of bibliographies on technical and scientific subjects
MATHMATICS
Wilfred E. Barnes, Ph.D., Head of Department


Opportunities for 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.

Opportunities for 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.

Satisfactory completion of 504, 505, 511, 514, 515, 516 or their equivalents is required for the M.S. or Ph.D. degree in this department. The written preliminary examination required for Ph.D. candidacy will be scheduled and administered by the department and will cover the fields of algebra, analysis (real and complex), and topology-geometry.

35. **ALGEBRA AND 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 part of the prerequisite for 50.
 Fractions, elementary algebra, linear equations, elements of geometry including congruence, parallel lines, circles, similar polygons, perimeters and areas, surface areas and volumes.

*101. 102. ALGEBRA AND TRIGONOMETRY. I, II.*
(5-0) Cr. 5 each. F.W.S.S.
Prerequisite: One and one-half units of high school algebra.
Elementary functions, analytic trigonometry, complex number field, theory of equations, probability, determinants, systems of linear equations.

*101B. ALGEBRA AND TRIGONOMETRY.*
(5-0) Cr. 3. SS.
Prerequisite: One unit of high school algebra.
Same material as first half of 101, plus remedial and supplementary material in algebra. Successful completion of this course will satisfy the entrance requirement for the third half-unit of high school algebra.

*101C. ALGEBRA AND TRIGONOMETRY.*
(3-0) Cr. 2. SS.
Prerequisite: 101B.
Same material as second half of 101.

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.
Prerequisite: One and one-half units of high school algebra.
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.
Prerequisite: 102.
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.

190, 191, 192. **MATHEMATICAL CONCEPTS.**
(3-0) Cr. 3 each. F.W.S.S.
Prerequisite: 190.
190, 192: One and one-half units of high school algebra.
190, 191 Structure of the number system 192 Geometrical concepts.

213. **ANALYTIC GEOMETRY AND CALCULUS IV.**
(3-0) Cr. 3. F.W.S.S.
Prerequisite: 112.
Infinite series, 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: 112.
301: Introductory set theory, development of the real number system. 302: Theory of groups, rings, integral domains, and fields.

304, 306. **DISCRETE AND CONTINUOUS MATHEMATICAL MODELS.**
(3-0) Cr. 3 each. 304: F.W. 305: W.S. 306: F.S.
Prerequisite: 112.

321, 322. **INTRODUCTION TO APPLIED MATHEMATICS I, II.**
(3-0) Cr. 3 each. F.W.S.S.
Prerequisite: 213.

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.
Prerequisite: 112.
112: Topological properties of the line and plane. Metric spaces and continuous transformations. Abstract spaces, continua, convergence, and fixed point theory.

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.
Prerequisite: 112.
Matrices and quadratic forms in the real and complex number fields.

406. **INTRODUCTION TO NUMERICAL TECHNIQUES FOR COMPUTERS.**
(C.S. 406) (3-2) Cr. 4. F.W.S.
Prerequisite: C.S. 214 or C.S. 223. Registration in 213.

407, 408. **NUMERICAL ANALYSIS I, II.**
(C.S. 407, 408) (3-0) Cr. 3 each. 407: W. 408: S.
408: Interpolation, numerical integration, numerical solution of ordinary differential equations, roots of polynomial and transcendental equations. Examples and problems programmed on available computers.

410, 411. **INTRODUCTION TO APPLIED MATHEMATICS III, IV.**
(3-0) Cr. 3 each. 410: F.W.S. 411: F.S.
Prerequisite: 410: 213, 411: 410.
410 Vector analysis 411 Functions of a complex variable.

414, 415, 416. ADVANCED CALCULUS.
(3-0) Cr. 3 each. 414: F.W.SS. 415: W.S.SS. 416: S.
Prerequisite: 213.
Partial differentiation and applications; multiple, line, and surface integrals; indeterminate forms; infinite series; improper integrals. In the schedule of classes a separate listing for 414A, 415A, 416A is given. The A-sequence is a more theoretically oriented approach to the topics listed above.

436, 437. PROJECTIVE GEOMETRY.
(3-0) Cr. 3 each. 436: W. 437: S.
Prerequisite: 301.
Geometric properties studied by synthetic and analytic methods.

450. NUMBER THEORY.
(3-0) Cr. 3. S.
Prerequisite: 302.
Properties of the integers. Diophantine equations; prime number distribution and representation problems.

COURSES PRIMARILY FOR GRADUATE STUDENTS, major or minor, open to qualified undergraduates

501, 502, 503. ANALYSIS OF LINEAR SYSTEMS.

504, 505, 506. ABSTRACT ALGEBRA.
(3-0) Cr. 3 each. Yr.
Prerequisite: 301.
Groups, integral domains and fields, modules and linear transformations, Boolean algebra and lattices.

507, 508. NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS.
(C.S. 507, 508) (3-0) Cr. 3 each. 507: F. 508: W.
Prerequisite: 408 or 415. Lamberti.
One-step methods for initial value problems, one-step methods for systems, multi-step methods, boundary value problems examples using university computers.

509. COMPUTATIONAL METHODS OF LINEAR ALGEBRA.
(C.S. 509) Cr. 3. S.
Prerequisite: 404. Lambert.
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.SS. 512: W.SS.
Prerequisite: 416. Colwell, Wright.
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.SS. 515: W.SS. 516: S.
Prerequisite: 416. Cornette, Mathews.

470, 471, INTERMEDIATE AND ADVANCED SYMBOLIC LOGIC.
(Phil. 470, 471) See History, Government, Philosophy.

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: 213.
Hons. Program.

* Credits earned by mathematics majors in 101, 102, 101s, and 101t do not apply to their undergraduate curriculum requirements.

Basic concepts of topological spaces, function spaces, measure and integration.

521, 522, 523. APPLIED MATHEMATICS.
(3-0) Cr. 3 each. Yr.

526, 527. INTEGRAL EQUATIONS.
(3-0) Cr. 3 each. Alt. Yrs. Offered 1969.
Prerequisite: 526: 511; 527: 516. Dyer, Kegley.
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: S.
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.

530. INTRODUCTION TO MECHANICS OF CONTINUOUS MEDIA.

531, 532. INTRODUCTION TO FUNCTIONAL ANALYSIS.
(3-0) Cr. 3 each. 531: W. 532: S.
Prerequisite: Permission of Instructor.
Homer.
Fundamental theory of linear operators in Hilbert space including unbounded operators and the spectral theory of compact, self-adjoint operators. Basic theory of linear
operators in normed linear spaces. Hahn-Banach theorem, closed-graph theorem, conjugate spaces, conjugate operators and introductory spectral theory.

534, 535, 536. TOPOLOGY.
(3-0) Cr. 3 each. Yr.
Prerequisite: 302, 333. Cornette, Sanderson. Foundations of point set theory. Introduction to homotopy and homology.

539. OPERATIONS RESEARCH.
(Stat. 539) See Statistics.

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: F. 555: W.
Prerequisite: 304, 416. Sample spaces, random variables, expectation, characteristic functions, limit theorems, stochastic processes.

557, 558. ORDINARY DIFFERENTIAL EQUATIONS.
(3-0) Cr. 3 each. 557: W. 558: S.
Prerequisite: 416 and permission of instructor.

562, 563. DIFFERENTIAL GEOMETRY.
(3-0) Cr. 3 each. Alt. Yrs. Offered 1968.
Prerequisite: Permission of instructor. Application of the calculus to the metric theory of space curves and surfaces; systems of curves, geodesics, ruled surfaces, minimal surfaces and intrinsic properties.

565, 566, 567. INFORMATION THEORY
I, II, III.

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.

591, 592, 593. QUANTUM PHYSICS.
(Phys. 591, 592, 593) See Physics.

599. SPECIAL TOPICS.
F.W.S.S.S. Graduate staff.

COURSES FOR GRADUATE STUDENTS, major or minor *

601. SPECIAL TOPICS.
Cr. 3 each time elected.
Prerequisite: Permission of instructor.
Graduate staff.

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. Head, Vinogradove. Associative algebras and rings, local algebras, homological algebra.

607. ADVANCED TOPICS IN NUMERICAL ANALYSIS.
(3-0) Cr. 3. S.
Prerequisite: 408 or 508, 509, 523. Lambert. Stability and error analysis, numerical solution of partial differential equations, successive over-relaxation methods, research work using University computers.

610. SEMINAR.
Graduate Staff.

611, 612, 613. ADVANCED TOPICS IN THE THEORY OF FUNCTIONS OF A SINGLE COMPLEX VARIABLE.
(3-0) Cr. 3 each. Yr.
Prerequisite: 536. Wright. 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.

621, 622, 623. ADVANCED TOPICS IN PARTIAL DIFFERENTIAL EQUATIONS.
(3-0) Cr. 3 each. Yr.
Prerequisite: 511, 521. Maple. Maximum principles, pointwise bounds, conservation equations, distributions, Hilbert space.

634, 635, 636. ADVANCED TOPICS IN TOPOLOGY.
(3-0) Cr. 3 each. Yr.
Prerequisite: 536. Sanderson. Topics selected from dimension theory, topology of manifolds, homotopy and homology theory, structure of continua.

642. PROBABILITY AND DISTRIBUTION THEORY.
(Stat. 642) See Statistics.

651, 652, 653. THEORETICAL ASPECTS OF COMPRESSIBLE FLOW AND TURBULENCE.

657, 658, 659. ADVANCED TOPICS IN ORDINARY DIFFERENTIAL EQUATIONS.
(3-0) Cr. 3 each. Yr.
Prerequisite: 515. Seifert. Existence, uniqueness, stability and asymptotic behavior of solutions of systems of ordinary differential equations; perturbation theory; control theory.

661, 662, 663. ADVANCED TOPICS IN ELASTICITY.

666, 667. THEORY OF PLATES AND SHELLS.

671, 672. THEORY OF PLASTICITY.

674, 675, 676. APPLICATIONS OF GROUP THEORY TO PHYSICS.
(Phys. 674, 675, 676) See Physics.

681, 682, 683. QUANTUM MECHANICS.
(Phys. 681, 682, 683) See Physics.

699. RESEARCH.
Graduate staff.

*These courses are offered on sufficient demand.
Opportunities for 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 were 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.

Opportunities for Graduate Study

The department offers major work for the degree 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.

130. MACHINE SHOP.  
(2-3) Cr. 2. F.S.SSI.  
Principles and practice of machine tool and bench working of metals. Machining of steel, cast iron, and non-ferrous metals.
211. ENGINEERING METALLURGY. (3-0) Cr. 3. F.W.SS.I.
Prerequisite: Chem. 102.
Basic principles of physical metallurgy, structure and solidification, mechanical and chemical properties, phase diagrams, heat treatment, ferrous and non-ferrous alloys.

232. METAL PROCESSING I. (2-2) Cr. 3. F.W.
Prerequisite: Chem. 102.
Principles of metallurgy applicable to manufacturing processes; heat treatment, machining processes.

233. METAL PROCESSING II. (2-2) Cr. 3. F.W.
Prerequisite: 211 or 232.
Application of principles of metallurgy to the fields of casting, mechanical working, welding, and powder metallurgy.

235. MECHANICAL BEHAVIOR OF METALS. (3-0) Cr. 3. F.S.
Prerequisite: 211 or 232 or A.E. 259; E.M. 324.
Plastic deformation, fracture, fatigue, creep and wear of metals. Mechanical and metallurgical aspects.

300. INSPECTION TRIP. Cr. R.S.
Prerequisite: Junior M.E. classification. Inspection trip to industrial centers.

305. TOOL ENGINEERING. (1-6) Cr. 3. W.S.
Prerequisite: E.M. 324, credit or classification in 233.
Design and application of special tools, jigs, and fixtures.

316. 317, 318. MACHINE DESIGN I, II, III. (4-0) Cr. 4 each. 316: F.W.SS.I; 317: W.S. SSII; 318: F.S.SS.I.
Prerequisite: 316: Credit or classification in 235, credit in Math. 321, E.M. 344; 317: 316; 318: 317.
Theory of machines. Kinematics and dynamics of mechanisms, design and selection of machine elements, vibratory phenomena, introduction to automatic control theory.

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. (4-0) Cr. 4. W.S.
Prerequisite: 321.

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.

340. ENGINEERING MEASUREMENTS. (1-6) Cr. 3. W.
Prerequisite: Junior classification, Math. 112, Phys. 223.
Engineering measurement 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, F.W. 412.

343. MECHANICAL ENGINEERING LABORATORY. (0-6) 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.SS.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: Arch. 313.
Elements of heat transfer, thermodynamics, and fluid flow as applied to heating, ventilating, and air conditioning. Design of duct and piping systems.

407. MECHANICAL EQUIPMENT DESIGN. (2-6) Cr. 4. S.
Prerequisite: 406.
Heat loss and gain calculations. Analysis of system types. Design and layout of heating, air conditioning, and plumbing systems in buildings.

411. INDUSTRIAL AUTOMATIC CONTROLS. (3-0) Cr. 3. F.S.
Prerequisite: 318, 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.

423. MECHANICAL SYSTEMS DESIGN. (1-9) Cr. 4. W.SS.S.
Prerequisite: 318.
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. F.S.SSI. 425: (4-0) Cr. 4. F.W.SSI.
Prerequisite: E.M. 344, Math. 410, 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.
(2-6) Cr. 4. S.
Prerequisite: 423, 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.
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.

440. FUELS AND COMBUSTION.
(4-0) Cr. 4. F.W.SSI.
Prerequisite: 322. Credit or classification in Chem. 381.

442. HEAT POWER LABORATORY.
(1-6) Cr. 3. W.S.
Prerequisite: 343, 425, 440.
Determination of the performance characteristics 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: 440.

448. STEAM POWER PLANT DESIGN.
(2-6) Cr. 4. S.
Prerequisite: 444.
Principal and auxiliary equipment for power, heating, and pumping plants. Cooling towers, boiler water treatment, principles of plant design.

487. SPECIAL PROBLEMS.
Cr. 3 to 6. F.W.S.
Prerequisite: Senior classification.
Investigation of topic holding special interest of student. Comprehensive report required. Election of course and topic must be approved by department head.

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, polede curvature, 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. S.
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 COMRESSIBLE FLOW I. (4-0) Cr. 4. W.
Prerequisite: 321 or 344, 424 or E.M. 378.

524. THERMODYNAMICS OF COMRESSIBLE FLOW II. (Aero.E. 524) (4-0) Cr. 4. W.
Prerequisite: 523.
Generalized one-dimensional steady internal flow. Theory of one-dimensional unsteady compressible flow. Two and three-dimensional compressible internal flow. Analysis and design of ducts, annuli, nozzles. Real fluid effects including boundary layer separation.

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 1968.
Prerequisite: 440.

541. 542, 543. ADVANCED AERODYNAMICS. (Aero.E. 541, 542, 543) See Aerospace Engineering.

544. PRINCIPLES OF TURBOMACHINERY. (4-0) Cr. 4. S.
Prerequisite: 523.

545. FLIGHT PROPULSION SYSTEMS. (Aero.E. 545) (3-0) Cr. 3. F.
Prerequisite: 523, 544 or Aero. E. 413.
Analysis and selection of propulsion systems for flight vehicles. Optimization of components and design parameters for atmospheric flight and for power and thrust generation in space.

549. EXPERIMENTAL GAS DYNAMICS AND SHOCK TUBE THEORY. (Aero.E. 549) (2-3) Cr. 3. S.
Prerequisite: 524 and permission of instructor.
Theory of shock tube operation for the production of shock waves with 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.


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.

* An undergraduate student must have an all-university average of at least 2.5 in order to enroll in any 500 Mechanical Engineering course.

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. S.
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. 621: W.; 622: Alt. S. Offered 1969.
Prerequisite: Permission of instructor.
Fundamental concepts of thermodynamics, thermodynamic laws, temperature, entropy, general thermodynamic equations, properties of steam, availability, equilibrium. Thermodynamics of thermolectricity. Special topics.


625. ADVANCED HEAT TRANSFER I. (3-0) Cr. 3. Alt. F. Offered 1968.
Prerequisite: 425 or equivalent.
Techniques for the analysis of problems involving steady-state and transient heat conduction.

626. ADVANCED HEAT TRANSFER II. (3-0) Cr. 3. Alt. W. Offered 1969.
Prerequisite: 425 or equivalent.
The boundary layer concept and its relation to convective heat transfer. Methods for analysis of the convection process in closed conduits and in flow past immersed bodies.

627. ADVANCED HEAT TRANSFER III. (3-0) Cr. 3. Alt. S. Offered 1969.
Prerequisite: 425 or equivalent.
Transfer of energy by thermal radiation.

642. ADVANCED PROBLEMS IN TURBOMACHINERY. (3-0) Cr. 3. Alt. W. Offered 1969.
Prerequisite: 542.
650. FLUID MECHANICS SEMINAR.  
(Aero.E. 650, E.M. 650)  
(1-0 to 3-0) Cr. 1 to 3 each time taken.  

Prerequisite: Permission of instructor.  
Special topics of current research interest to students and staff of departments concerned.

655. RESEARCH.  

METALLURGY  

John F. Smith, Ph.D., Chairman of Department

Professors: O. Norman Carlson, Ph.D.; Premo Chiotti, Ph.D.; David T. Peterson, Ph.D.; Frank H. Spedding, Ph.D.; Harley A. Wilhelm, Ph.D.

Associate Professors: Chih W. Chen, Ph.D.; Karl A. Gschneidner, Jr., Ph.D.; William L. Larsen, Ph.D.; Marion J. Marcinkowski, Ph.D.; John D. Verhoeven, Ph.D.

Assistant Professors: Francis X. Kayser, Sc.D.; John W. Patterson, Ph.D.; Tom E. Scott, Ph.D.; Rohit K. Trivedi, Ph.D.

Instructor: Donald M. Bailey, M.S.

Opportunities for 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 include the following basic courses: 201, 202, 203, 301, 302, 303, 305, 306, 307, 401, 402, 403, 421, and 9 additional credits in courses numbered 400 or above. As supporting work undergraduate majors find the following courses desirable: Math. 110, 111, 112, 213, 321, 410; Physics 221, 222, 223, 301, 302, 303; Chem. 101, 102, 103, 321, 322, 323. These lists of courses are not regarded as statements of fixed requirements or as complete outlines of work necessary for the major. Students will plan their complete programs according to their individual needs with the help of their advisers.

Opportunities for 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.

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, 401, 402, 403, 408, 410, 421, 431, 432, 433.

COURSES PRIMARILY FOR UNDERGRADUATE STUDENTS

100. TECHNICAL LECTURE. (1-0) Cr. R. S.
Introduction to the metallurgical profession.
Career opportunities and requirements

201, 202, 203. INTRODUCTORY METALLURGY. (3-0) Cr. 3 each Yr.
Prerequisite: Chem. 103, 201 is not prerequisite to 202.
201 Occurrence and preparation of metals, stoichiometry, and material balances. States of aggregation and microstructure. 202 Introduction to types of bonding, crystal structure of solids, crystal imperfections and their effect on properties. Mechanics of deformation. 203 Mechanical properties of metals and testing procedures, metal processing techniques, alloying principles and engineering applications.

231. METALLURGY FOR ENGINEERS. (3-0) Cr. 3. W.S.
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.

301, 302, 303. PHYSICAL METALLURGY. (3-0) Cr. 3 each Yr.
Prerequisite: 203, classification in Chem. 321.
301 Stereography, x-ray diffraction, basic dislocation theory, deformation of metals. 302 Grain boundaries, grain growth, vacancies, diffusion, nucleation, solidification, recovery and recrystallization. 303 Solid solutions, precipitation hardening, twinning and martensite reactions, transformation kinetics, strengthening processes.

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.

401, 402, 403. ENGINEERING METALLURGY. (3-0) Cr. 3 each Yr.
Prerequisite: 303.
401, 402. Application of phenomenological elastic and plastic deformation concepts to metallurgical problems and operations such as forging, mechanical failures, creep, fatigue and fractures. 403 Casting, joining, powder metallurgy, surface treatment, residual stresses.

408. METALLOGRAPHY. (1-0) Cr. 3. S.
Prerequisite: 305.
Optical principles and use of the metallurgical microscope. Theory and practice of specimen preparation. Qualitative and quantitative interpretation of observed structures.

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.

421. METALLURGICAL THERMOCHEMISTRY. (3-0) Cr. 3. W.
Prerequisite: Chem. 323.
Application of thermodynamics to metallurgical processes.

431. PHYSICAL METALLURGY. (4-0) Cr. 4. F.
Prerequisite: Chem. 323 or 381.
Fundamentals of physical metallurgy, atomic and crystal structure, phase diagrams, physical and mechanical behavior, corrosion, diffusion, recrystallization, solid state phase transformation. 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.
Prerequisite: Junior classification.
Investigation of individual research problems or special topics with approval of adviser.

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. 410.
532. STRUCTURE AND PROPERTIES OF STEEL.  
(3-0) Cr. 3. S.  
Prerequisite: 303, 410 or 431.  
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. 410.  
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. Mechanisms 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: 303 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.

562. METALLURGICAL THERMODYNAMICS.  
(3-0) Cr. 3 each. 562: F; 563: W.  
Prerequisite: Chem. 323.  
The application of thermodynamics to the study of metals, heterogeneous equilibria in alloy systems, thermodynamic properties of liquid and solid solutions and relation to the phase diagram, surfaces and defects in solids. Determination of thermodynamic properties.

594. SPECIAL TOPICS IN METALLURGY.  
Cr. arr. Offered on request.  
Prerequisite: Permission of Instructor.  
Topics of current interest in metallurgy.

COURSES FOR GRADUATE STUDENTS, major or minor

610.  ALLOY THEORY.  
(3-0) Cr. 3 each. Alt. F. 610 offered 1968; 611 offered 1967.  
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 1968.  
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. Moiré effects. Other techniques for observation of imperfections. Emphasis will be placed on metals and alloys.

655. X-RAY SCATTERING FROM CRYSTALS.  
(3-0) Cr. 3 each time taken. Alt. S. Offered 1969.  
Prerequisite: Math. 322, 410.  
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.

665. DIFFUSION IN SOLIDS.  
(3-0) Cr. 3. Alt. S. Offered 1967.  
Prerequisite: 511.  
MUSIC

N. Laurence Burkhalter, Ph.D., Head of Department

Professors: Alvin R. Edgar, D.Mus.; Frank A. Piersol, M.A.

Associate Professors: Richard Koupal, M.M.; Ilza Niemack; Ira Schroeder, B.Mus.


Opportunities for Undergraduate Study

For undergraduate curriculum in sciences and humanities, major in music, leading to the degree Bachelor of Science, see College of Sciences and Humanities, Curricula. The music major requires 44 credits in music, plus the attainment of specified standards in performance repertoire and technique. Students will be accepted as a major after examination by the Department of Music as indicated below. Options allow emphasis on (1) preparation for teaching positions or (2) greater concentration on performance styles and musicological aspects of music. Specific requirements are as follows:

1. All music majors will present 29 credits in basic music, to include 12 credits in harmony, Music 201, 202, 203; 6 credits in practical theory, Music 304, and 305 or 306; 9 credits in music history, Music 355, 356, 357; and 2 credits in conducting, Music 361, 362.

2. 15 credits will be selected for special emphasis in Option I or Option II as follows:

Option I. Music Education. Students desiring to teach vocal or instrumental music must apply to and be accepted by the Department of Music and the University Committee on Teacher Education. Students who complete requirements for the major as well as those listed for teacher certification will be recommended for the Iowa Professional Certificate. Endorsement may be obtained for teaching elementary-secondary music (kindergarten and grades 1 through 14).

Courses in this option should include 9 credits in music education, Music 363, 365 and 366. Students preparing to teach instrumental music will also complete at least 4 credits in practicum, Music 367, 368, 369. Electives in music should be chosen to complete the 15 music credits in this option.

Requirements for secondary education will include 6-12 credits in student teaching. Education courses will apply as one area of minor study. The second minor area should meet individual interests, usually in the humanities. Suggested minors: English, foreign languages, history, literature, and philosophy.

Option II. Music Literature and Performance. Preparation for graduate study or for positions in church music, musicology, theory or performance assumes a high standard of musical achievement and may require study beyond the usual four-year academic calendar. See paragraph 3 below. Courses in this option will include 9 credits in music literature selected from Music 371, 373, 374, 376 and 390C or 390D, and 6 credits in Music 390B, Special Topics in Music Theory.

Minors should be selected to increase historical and artistic perspective. Courses in foreign languages, history, literature, philosophy are important. Vocalists will be advised to give emphasis to languages.

3. Proficiency in music repertoire and technique will be determined by departmental examination as follows:
a. Acceptance examination. To be accepted as a music major in either option the student must demonstrate rhythmic and tonal dependability in at least one performing medium. Applicants will be tested in aptitude, hearing and interest; results will be used in advising the student as well as in determining his acceptability. Students who have not studied or participated in music in high school or previous college years should not choose music as a major.

The acceptance examination will be given by members of the Department of Music faculty on an appointment basis during summer orientation or during the week preceding the opening of classes for any quarter. Students should request this examination in the Department of Music office before deciding on the music major.

b. 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

(1) Ability to use the keyboard instruments as a study and teaching tool.
(2) Acceptable solo ability in at least one instrument or voice, including understanding of performance technique.

Students who meet these requirements will be approved to continue the major. Only those who show outstanding ability should continue in Option II.

c. Graduation proficiency. To be recommended for graduation with a major in music, students should demonstrate mature acquaintance with performance styles, technique and repertoire.

Students emphasizing music education must show, in the appropriate area, understanding of:

(1) Vocal production, voice testing and problems of the untrained voice, or
(2) Performance and teaching techniques in at least two instrumental areas (woodwinds, brass and percussion, or strings).

All music majors will participate in departmental recitals to the satisfaction of the department, and will present a solo public recital during the senior year. Solo recitals will be presented for faculty review approximately six weeks before scheduled public performance.

Music repertoire and technique requirements, although they do not offer credit, are of great importance in the study of music. Normally students will be expected to take private lessons throughout their undergraduate years. In many cases additional quarters of performance study may be required, extending the period of undergraduate training beyond the usual four-year period.

Students should register without credit for each term of private or class applied study, the course number to be designated by the Department of Music. Students will be expected to attain performance proficiency indicated by 400-level registration in at least one instrument before graduation. Transcripts will record dates of satisfactory completion of proficiency examinations.

All university students are eligible for membership in the performing organizations under the direction of the music faculty. Music majors should include at least 10 credits in performance organizations in their program. Selection for the various bands, choruses and orchestras is based upon requirements of the particular organization and the qualifications of the individual. Students receive training in the skills of musical performance in these organizations, in the smaller ensembles and in class or private lessons. Academic courses offer an opportunity to cultivate an understanding of historical and theoretical aspects of music.

Students are urged to seek advice of the Department of Music before selecting music courses. Performance and listening background are considered guides in this decision. Credits in music may be applied as electives in all colleges and may be selected for the minor at the discretion of the major department and with the recommendation of the Department of Music.
COURSES PRIMARILY FOR UNDERGRADUATE STUDENTS

IOWA STATE UNIVERSITY FESTIVAL CHORUS.
Members of student body and faculty are eligible. Interpretation of choral work, secular and sacred.

100. FUNDAMENTALS OF MUSIC.
(3-0) Cr. 3. F.W.S.
Notation, recognition and execution of intervals and rhythms, key signatures and scale patterns. May be advised as prerequisite to Music 201.

111, 112, 113. BANDS.
(2-0) 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.
Cr. R. F.W.S.S.S.
One 30-minute lesson per week, minimum weekly practice 5 hours. Two 30-minute lessons per week, minimum weekly practice 10 hours. Course number indicating proficiency level, will be assigned by the Department of Music.
Private instruction in instrument or voice. See Fees and Expenses.
A. Voice
B. Piano
C. Organ
D. String Instruments
E. Band Instruments

129, 229, 329. CLASS STUDY IN APPLIED MUSIC.
Cr. R. (1-0) F.W.S.
Prerequisite: Permission of Head of Department of Music.

Class study in instrument or voice. See Music 119, etc. for letter designation for various instruments.

141, 142, 143. MEN'S GLEE.
(2-0) Cr. 1 each. Yr.
Glee clubs are open to all students by application to the director. Rehearsals twice weekly, plus Festival Chorus.

151, 152, 153. ORCHESTRAS.
(1-0) Cr. 1 each. Yr.
Open to all students who qualify. Concerts presented each quarter; annual tour fall quarter.

161, 162, 163. IOWA STATE SINGERS.
(3-0) Cr. 1 each. Yr.
Open to all students who qualify.

201. HARMONY I.
(4-0) Cr. 4. F.
Prerequisite: Permission of instructor.
Scale structure, chord spelling, keyboard facility required.

202. HARMONY II.
(4-0) Cr. 4. W.
Prerequisite: 201.
Harmonization and analysis. Continuation of Music 201.

203. HARMONY III.
(4-0) Cr. 4. S.
Prerequisite: 202.
Continuation of Music 201, 202. Includes creative writing.
304. MUSICAL FORMS.  
(3-0) Cr. 3. F.  
Prerequisite: 203.  
Harmonic and formal analysis of the smaller forms in music; practical adaptation in composition.

305. CHORAL ARRANGING.  
(3-0) Cr. 3. W.  
Prerequisite: 203.  
Principles of harmonic distribution applied to choral music; melodic and rhythmic problems in choral writing; practical arranging.

306. INSTRUMENTATION.  
(3-0) Cr. 3. S.  
Prerequisite: 203.  
Transposition, ranges and use of orchestral instruments; practical application to compositions for single and combined instrumental choirs.

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.

354. 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.

355, 356, 357. HISTOR Y OF MUSIC.  
(3-0) Cr. 3 each. Yr.  
Prerequisite: 354. Should be taken in sequence.

355: The history of music from ancient times and extending through the Renaissance and baroque practice.  
356: The music of Bach and Handel, the classics, Beethoven and the romantics.  
357: Later romantic development and its influences in shaping contemporary styles. Contemporary music.

361. CONDUCTING I.  
(1-1) Cr. 1. F.  
Prerequisite: Permission of department head.  
Basic training in conducting and rehearsal techniques. Emphasis on vocal practice and choral literature.

362. CONDUCTING II.  
(1-1) Cr. 1. W.  
Prerequisite: 361.  
Score reading. Emphasis on instrumental techniques. Continuation of Music 361.

363. HISTORY AND PHILOSOPHY OF MUSIC EDUCATION.  
(3-0) Cr. 3. F.  
Prerequisite: Admission into teacher preparation program in music, permission of instructor.  
Historical development of music education in the United States, current philosophies and purposes of music programs in elementary and secondary schools.

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. Keyboard ability required.

366. MUSIC IN THE SECONDARY SCHOOLS.  
(3-0) Cr. 3. S.  
Methods and materials for teaching and supervision of music in the junior and senior high schools. Preparation for direction of music as an activity.

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.

371. HISTORY OF CHURCH MUSIC.  
(3-0) Cr. 3. F.  
Prerequisite: Permission of instructor.  
Survey of the stylistic development of sacred music and the relationship of music to various theologies and liturgies.

373. HISTORY AND PERFORMANCE OF OPERA I.  
(3-0) Cr. 3. F.  
Prerequisite: Permission of instructor.  
Historical study of opera. Includes problems of casting and directing, with public performance as cumulative project.

374. HISTORY AND PERFORMANCE OF OPERA II.  
(3-0) Cr. 3. W.  
Prerequisite: Permission of instructor.  
Continuation of Music 373. Survey of periodic and national styles in opera.

376. ORGAN LITERATURE AND PERFORMANCE.  
(3-0) Cr. 3. S.  
Prerequisite: Permission of instructor.  
Historical survey and practical study of the organ and its literature; techniques of service playing.

390. SPECIAL TOPICS.  
Cr. Var. F.W.S.  
Prerequisite: Permission of department head.  
A. Music Education.  
B. Music Theory.  
C. Music Literature.  
D. Music History.  
H. Honor's 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.

Assistant Professors: Achilles G. Adamantiades, Ph.D.; Paul W. Barcus, Ph.D.; Howard Bell, Ph.D.; Richard A. Hendrickson, Ph.D.; Phillip A. Loretan, Ph.D.; Benjamin M. Ma, Ph.D.; Alfred F. Rohach, Ph.D.; Richard E. Turley, Ph.D.; Agust Valfells, Ph.D.

Instructors: Michael C. J. Carlson, M.S.; Knud B. Pederson, M.S.

Opportunities for 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.

Opportunities for Graduate Study

Major work is offered for the degrees Master of Science and Doctor of Philosophy in nuclear engineering. Minor work in nuclear engineering and in engineering similitude is offered to students taking major work in other departments.

Prerequisite to major work is the completion of a curriculum substantially equivalent to that required of undergraduate students in engineering at this institution. It is recommended that students contemplating graduate studies in nuclear engineering include courses in modern physics, heat transfer, chemistry beyond freshman chemistry, and mathematics beyond differential equations as part of their undergraduate preparation.

The foreign language requirement for the degree Master of Science may be waived upon recommendation of the head of the department.

COURSE PRIMARILY FOR UNDERGRADUATE STUDENTS

474. INTRODUCTION TO NUCLEAR ENGINEERING.
(3-0) Cr. 3. F.W.S.
Prerequisite: M.E. 344, Math. 321 or permission of instructor.
Basis and problems of nuclear power development; considerations in nuclear reactor design, radiation hazards and shielding; use of radioisotopes in industry

COURSES PRIMARILY FOR GRADUATE STUDENTS, major or minor, open to qualified undergraduates

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 and fluid 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.S. 351.
Influence of structure and environment on the mechanical properties of engineering materials. Types of imperfections and their effects. Control of properties.
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. (1-4) 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: 536.

581. 582. 583. REACTOR ANALYSIS. (3-0), (2-2), (2-2) Cr. 3 each. F.W.S.
Prerequisite: 537, Math. 408.
Application of numerical analysis techniques to thermal and fast reactors,

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.

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. Reactor systems, thermonuclear developments, fission, fusion and mass-energy transducers.

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.

684. 685. 686. 687. SIMILITUDE IN ENGINEERING. (2-2) Cr. 3 each. F.W.S.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 following branches of the military service: Army, Navy, and Air Force.

The University changed from compulsory ROTC to voluntary ROTC when it was recognized that the philosophy toward ROTC had changed through the years. Basic ROTC was no longer considered by the Department of Defense as needed to help prepare a large number of men for military service in the event of emergency. The concept of basic ROTC had changed to be a prerequisite for officer education. The present purpose of advanced ROTC is that of preparing officers to serve in military forces following graduation rather than merely holding a reserve commission in the event of emergency. The Navy and Air Force in particular are requiring a period of commission service long enough to encourage the 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, or partial preparation for a career, since each graduate will spend two or more years in military service.

ROTC is recognized as a subject matter area of specialization because of its growing importance in career planning. Three 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 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.

AIR FORCE AEROSPACE STUDIES

Lt. Col. Paul W. Von Wiedenfield, B.A., Head of Department

Assistant Professors: Capt. John D. Flood, M.A.; Capt. James L. Lee, Jr., B.A.; Capt. Donald E. Thompson, B.B.A.


Opportunities for Undergraduate Study

Iowa State University, a land-grant institution, has offered courses in AFROTC since 1946. It is a voluntary program. All physically qualified male students are eligible and encouraged to enroll toward gaining an officer's commission.

The mission of the AFROTC is to produce officers of appropriate quality to satisfy stated Air Force officer requirements. The objectives of the AFROTC are:

a. To provide education that will develop skills and attitudes vital to the career professional Air Force officer.

b. To qualify for commissions those college men who desire to serve in the United States Air Force.

The first two years of AFROTC consists of the general military course; the last two years constitute the professional officer course. The general military course places special emphasis on personal development and practical military instruction (Leadership Laboratory) to develop qualities that are essential to the professional Air Force officer. A six-week Officer Basic Military Training Course (OBMT) conducted at an Air Force base between the sophomore and junior years may be substituted for the two-year general
military course on campus. Students who desire to substitute the six-week OBMT for the
general military course on campus will be given physical and mental examinations by the
Air Force during their sophomore year in order to qualify for this training. While under­
going OBMT cadets are paid $78 per month plus travel expenses and are furnished hous­ing and meals. General military training, either on campus or OBMT at an Air Force
base, must be completed as a prerequisite for entry into the professional officer course.

All cadets must meet certain mental, physical and moral standards before they are
selected for the professional officer course. Dependent upon physical qualification, advanced
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 through­
out the United States. In addition, there is a cadet flight instruction program for seniors
in the pilot category conducted at the Ames airport. Upon satisfactorily passing the FAA
requirements, a cadet completing this program is eligible for a private pilot's license.

The student is furnished a complete uniform and books while enrolled in the program.
In the professional officer course, he is paid a retainer fee of $40 per month for a period
of 20 months and must attend a summer training period of four weeks' duration, normal­
ly between his junior and senior years. The government pays for travel and provides
housing and meals in addition to paying $115 per month during this training period.

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 attain a degree will re­
cieve a commission as a 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. WORLD MILITARY SYSTEMS.
(1-1) Cr. 1 each Yr.
Causes of present world conflict, the role
and relationship of military power to that
conflict, and the responsibility of an Air
Force officer. Factors from which differing
political philosophies have evolved. Ana­
lysis of the three prime political philosophies
which have guided segments of society in
the twentieth century. Means that nations
develop to pursue their objectives and how
they confront each other in the use of these
means. Individual military systems, with
emphasis upon the U.S. Department of De­
fense and the U.S. Air Force.

241, 242, 243. WORLD MILITARY SYSTEMS.
(1-1) Cr. 1 each Yr.
Prerequisite: 143.
World military forces and the political-
military issues surrounding the existence of
these forces, including the United States
Army and the United States Navy, their
doctrines, missions and employment con­
cepts; military forces of NATO, CENTO,
SEATO, and their role in free world se­
curity; military forces of the USSR, Soviet
satellite armies, and the Chinese Communist
army. Analysis of the trends and implica­
tions of world military power.

341, 342, 343. GROWTH AND
DEVELOPMENT OF AEROSPACE POWER.
(3-1) Cr. 3 each Yr.
Prerequisite: 243.
The nature of war; development of air
power in the U.S.; mission and organiza­
tion of the Defense Department; Air Force
concepts, doctrine and employment; astron­
autics and space operations; future develop­
ment of aerospace power.

441, 442, 443. THE PROFESSIONAL
OFFICER.
(3-1) Cr. 3 each Yr.
Prerequisite: 343.
Professionalism, leadership, and manage­
ment, including the meaning of profession­
alism, professional responsibilities, the mil­
itary justice system, leadership theory, func­
tions, and practices, management principles
and functions, problem solving, and man­
agement tools, practices and controls.
Since before the establishment of our national government, reliance has been placed upon citizen armies for defense, rather than upon a large standing army of professional soldiers. It is part of the American tradition that citizenship carries with it certain obligations, as well as privileges. The founders of Iowa State University early recognized the need for a citizenry trained in military matters. From the date Iowa State University was established, the University has conducted training in Military Science and Tactics.

The United States Army ROTC program is designed to prepare college students for positions of leadership and responsibility in the U.S. Army. This instruction is divided into the basic course, Military Science I and Military Science II; and the advanced course, Military Science III and Military Science IV.

Military Science I provides instruction in the organization of the national defense establishment, use of individual weapons and rifle marksmanship. Military Science II provides instruction in map reading, basic tactics, American military history, and counter-insurgency operations. Uniforms for the basic course are furnished upon payment of a $15 deposit, which is refunded when the uniform is returned in good condition. The basic courses, Military Science I and II, are prerequisites for the advanced course: however, students who have not completed the basic course may apply for the advanced program and will be accepted upon completion of a qualifying medical examination and completion of a six weeks basic training summer camp, this camp taking the place of the basic course. The basic training summer camp is conducted at an active Army installation during the summer prior to entrance into the advanced program. All travel and living expenses are paid by the U.S. Army along with a monthly stipend of $78 per month while attending summer camp. This method of entering into the advanced ROTC program is open to all students who have two years' academic work remaining before attaining their baccalaureate.

The advanced course is offered to qualified students who have completed the basic course or have fulfilled the alternative requirements listed above, and who are taking third and fourth year work in college. The student must volunteer and be accepted for this course. The advanced course is designed to prepare students for positions as commissioned officers, either in the U.S. Army Reserve or in the Regular Army. Instruction is based upon a general military science curriculum which prepares the student for any branch of the U.S. Army. An on-campus flight program is also offered which qualifies the student for a private license at no expense to the student.

Advanced course students attend a six weeks' summer camp during the summer after their first year in the advanced course. This camp is required of all students, including those who entered directly into the advanced program. This camp provides the opportunity for application of the subject matter learned during the campus phase of ROTC. Students are furnished travel expenses, uniforms, food, and billeting at no cost to themselves and in addition are paid $120.60 per month during the camp.

Advanced course students receive officer-type uniforms tailored to individual measurements. These are provided by a monetary allowance paid to the University by the U.S. Army. A uniform deposit is required of each student upon his entry into the advanced course. This deposit is refunded upon completion of the course, and the student is permitted to retain the uniform.

Retainer pay of $40 per month is paid to all advanced course students for a total of 20 months including quarter breaks and holidays. This pay begins on the date classes start for the first quarter in which a student commences the advanced course.
COURSES PRIMARILY FOR UNDERGRADUATE STUDENTS

111, 112, 113. MILITARY SCIENCE I.
(1-1) Cr. 1 each.
Leadership; individual weapons and marksmanship; organization of the Army and ROTC; United States Army and national security.

211, 212, 213. MILITARY SCIENCE II.
(1-2) Cr. 1 each.
Prerequisite: Military Science I or approval of Professor of Military Science.
Leadership; map and aerial photographic reading; introduction to basic tactics, American military history and counter-insurgency operations.

301, 302, 303. MILITARY SCIENCE III.
(3-1) Cr. 3 each.
Prerequisite: Military Science I and II or completion of six weeks' basic training summer camp, approval of Professor of Military Science.
Leadership; military teaching principles; small unit tactics and communications; branches of the Army; counter-insurgency operations.

NAVAL SCIENCE

COL. Russell R. Riley, USMC, B.A., Head of Department

Associate Professors: CDR Elmer L. Crance, USN, B.A.
Instructors: LT. William H. Knapp, USN, B.A.; MAJ. Billy D. Kraxberger, USMC, B.A.; LCDR, Ralph S. Larson, USN, B.S.; LT. Thomas D. Smith, USN, B.S.; LT. Roger L. Williams, USNR, B.S.

The first Naval Reserve Officers Training Corps units were established in 1926. There are now 53 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 sophomore year, every Regular NROTC student must have satisfactorily completed one year of college physics and one year of college mathematics.

b. By the end of the sophomore year Contract students must have satisfactorily completed one quarter of college mathematics or mathematics courses through trigonometry in secondary school.

c. Every student must achieve proficiency in written and oral expression in accordance with the standards prescribed by the University.

It is desirable that every student complete the following:

a. A sequence in mathematics, extending through calculus, and including spherical trigonometry.

b. A second year of physical science, such as advanced electricity and elementary electronics, for other than engineering students.
Description of Courses

c. A one-year sequence in personnel management and administration.
d. A one-year course in world politics and international organization.
e. Two years of foreign language, or demonstrate by examination that he possesses a good reading knowledge and can make an acceptable written translation of one foreign language.
f. A course in public speaking.

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 science, dairy science, dairy manufacturing, dairy production, entomology, general agriculture, horticulture, hotel administration, industrial arts, landscape architecture, music, physical education, poultry science, pre-dental, pre-medicine, pre-veterinary, 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 provide the student with a well-rounded course in basic subjects which, in conjunction with a baccalaureate degree, will qualify him for a commission in the United States naval service.
2. To develop a knowledge of, and interest in, naval customs and traditions.
3. To develop a capacity for leadership.

Opportunities for 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, 321, 322, 323, 421, 422 and 423 with minors in mathematics and choice of physics or engineering curricula. 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. Three quarters of physics and Psych. 101 must be included, and the following courses should be included in group requirements or electives: Geol. 321 or 322; E.E. 341, 342; Hist. 311, 312, 313; Govt. 556; Engr. Gr. 131, 132; Chem. 101, 102, 103.

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. EVOLUTION OF SEA POWER AND NAVAL ORIENTATION.
(3-2) Cr. 3 each. Yr.
111: Naval orientation. Naval customs, organization, and basic seamanship. 112: Influence of sea power upon history from early Mediterranean civilization to World War I. 113: Influence of sea power upon history from World War I to the present.

211, 212, 213. NAVAL WEAPONS.
(3-2) 211, 213: Cr. 3 each. 212: Cr. R. Yr.
211: Basic principles of naval weapons and fire control; antiaubmarine warfare. 212: Naval Weapons Laboratory. Psych. 101 will be taken in lieu of lecture periods. However, NROTC students will enroll for the standard laboratory periods. 213: Basic principles of guided missiles, nuclear weapons; space technology.

311M. HISTORY OF THE ART OF WAR.
(3-2) Cr. 3. Alt. F. Offered 1967.
The study of the history of the development of the art of land warfare from Alexander the Great to the Civil War.

312M. UNITED STATES MILITARY HISTORY AND POLICY.
(3-2) Cr. 3. Alt. W. Offered 1968.
The study of 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 1968.
The study of the 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.
321: Navigation procedures including piloting, dead reckoning and radar; theory of celestial navigation. 322: Celestial navigation problems. Maneuvering instructions and problems. 323: Rules of the road; fleet operations and communications
411M. HISTORY OF UNITED STATES AMPHIBIOUS WARFARE.
(3-2) Cr. 3. Alt. F. Offered 1968.
The study of 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 1969.
The study of 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 1969.
The study of the Uniform Code of Military Justice and the use of the Manual for Courts-Martial followed by a consideration of administrative, psychological and sociological techniques of value in assisting an officer in the fulfillment of his responsibilities.

411, 412, 413. NAVAL ENGINEERING AND PRINCIPLES AND PROBLEMS OF LEADERSHIP.
(3-2) Cr. 3 each. Yr.
411. Theory, construction and typical operation of modern naval engineering installations; introduction to thermodynamics. Satisfactory completion of M.E. 321 and 322 or M.E. 344 or Ch.E. 461 may be substituted for lecture periods, with approval from heads of departments involved. However, NROTC students will enroll for the standard laboratory periods. 412: Theory and construction of nuclear marine propulsion systems; construction and operation of diesel engines; principles of ship stability. Naval use of the principles of human relations, human management practices and leadership. 413: A brief study of the Uniform Code of Military Justice. The administrative duties and responsibilities of the naval officer as they relate specifically to problems incident to duty with the Navy.

PHILOSOPHY

For description of courses, see History, Government and Philosophy.

PHYSICAL EDUCATION FOR MEN

Gordon H. Chalmers, B.S., Head of Department


Associate Professors: Russell E. Dickinson, M.A.; Ray O. Donels, M.A.; Jack M. McGuire, B.S.; Clay Stapleton, B.S.; Clayton Sutherland, B.A.


Opportunities for Undergraduate Study

For undergraduate curriculum in physical education, administered under the College of Sciences and Humanities, leading to the degree Bachelor of Science, see Sciences and Humanities, Curriculum.

The curriculum in physical education prepares the student to teach physical education, to coach athletics or to direct recreational programs for schools, camps, industries or communities. The physical education teacher should be prepared to teach in at least one other subject-matter area. For Teaching and Coaching, see Index.

Each student's program is designed to fit his particular needs and interests. Specific inquiries should be directed to the department head.

The work of the department also includes basic instruction for freshmen and sophomores and competitive programs in intramural and intercollegiate athletics.
In the basic instruction program it is the aim of the department to promote the health, organic vigor and good physical habits of the student. To accomplish this, a program is offered which will afford the student the opportunity to participate in and to develop a reasonable degree of skill in a variety of leisure time activities for immediate and later recreational appreciation and enjoyment.

Through the intramural program every man is given an opportunity to participate in competitive sports. The intramural program includes touch football, softball, basketball, volleyball, wrestling, tennis, indoor and outdoor track, handball, horseshoe pitching, baseball, golf, archery, fencing, hockey, table tennis, and swimming. The facilities of the department include an 18-hole golf course, 21 tennis courts, an ice skating area, playfields, State Gymnasium with pool, and Beyer Hall with gymnasium, pool, handball courts, squash courts, wrestling room, gymnastic room, and individual exercise room.

Basic Instruction Program Courses

Requirement:
All male students except those exempted are required to take a one-credit activity course in each of their first six quarters of student residence.

Exemptions: The following students are exempt from this requirement:
1. Those certified as physically unfit by the Student Health Service.
2. Those who, at the time of matriculation, have passed their twenty-third birthday.
3. Other exemptions at the discretion of the department head, such as proven proficiency in sports as demonstrated by examination.

COURSES PRIMARILY FOR UNDERGRADUATE STUDENTS

101. FRESHMAN PHYSICAL EDUCATION.
(0-2) Cr. 1. F.
Classification and orientation in physical education activities.

102. FRESHMAN PHYSICAL EDUCATION.
(0-2) Cr. 1. W.
Orientation in recreational sports.

103. FRESHMAN PHYSICAL EDUCATION.
(0-2) Cr. 1. S.
Orientation in recreational sports.

Aquatics

This group of courses is graduated to accommodate teaching the student the skills of swimming on the basis of his individual ability classification.

111. BEGINNING SWIMMING I.
(0-2) Cr. 1. F. W.S.S.I, S.S.II.

112. BEGINNING SWIMMING II.
(0-2) Cr. 1. W.S.S.I, S.S.II.

113. ADVANCED SWIMMING.
(0-2) Cr. 1. S.

Team Sports

122. BASKETBALL.
(0-2) Cr. 1. W.

125. VOLLEYBALL
(0-2) Cr. 1. W.S.
Techniques and practice.

110. INDIVIDUAL PRESCRIBED ACTIVITIES.
(0-2) Cr. 1. F.W.S.
Prerequisite: Prescription of Student Health Services.
Activities are assigned in accordance with the student's need in one of the following categories.
A. A sport adapted to the student's physical capacity and interest.
B. A program of exercise for physical rehabilitation following illness or accident.
C. A program of exercise designed toward the correction of a physical defect.

114. LIFE SAVING.
(0-2) Cr. 1. W.S.

115. WATER SAFETY.
(0-2) Cr. 1. F.S.

116. SKIN AND SCUBA DIVING.
(0-2) Cr. 1. F.W.S.
Prerequisite: Expert swimmer classification.
Instruction in skills, use of equipment, and safety practices in scuba diving.

Combatives

133. FENCING I.
(0-2) Cr. 1. F.W.S.

134. FENCING II.
(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.S.
144. BAITCASTING. (0-2) Cr. 1. F.S.
147. BOWLING. (0-2) Cr. 1. F.W.S.
149. GOLF I. (0-2) Cr. 1. F.S.SSI,SSII.
150. GOLF II. (0-2) Cr. 1. F.S.SSI,SSII.
151. GYMNASTICS I. (0-2) Cr. 1. F.W.S.

**Leadership Activities**

These courses are designed to provide leadership experiences under staff supervision in areas as indicated by name.

162. SPORTS OFFICIATING. (0-2) Cr. 1. F.W.S.

**Co-Educational Activities**

173. SQUARE DANCING I. (0-2) Cr. 1. W.

**Varsity Sports**

190. SPORTS PARTICIPATION.
Cr. 1 each.
Transfer to freshman and varsity sport squads upon permission of coach. Identify by use of suffix.
A. Band. F.
B. Baseball. F.S.
C. Basketball. F.W.

**Professional Program**

212. GYMNASTICS. (1-4) Cr. 3. F.W.
Techniques and theory of gymnastic activities, including tumbling and apparatus.

213. INTRODUCTION TO PHYSICAL EDUCATION. (3-0) Cr. 3. F.
An introductory course designed to develop leadership techniques, measure aptitudes, and orient each student in the general areas of physical education.

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 and practice in fundamental skills of basketball.

216. TRACK AND FIELD TECHNIQUES. (1-4) Cr. 3. S.
Instruction and practice in fundamental skills of track and field events.

217. BASEBALL TECHNIQUES. (1-4) Cr. 3. S.
Instruction and practice in fundamental skills of baseball.

218. ADVANCED SWIMMING TECHNIQUES. (1-4) Cr. 3. F.W.S.
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. W.
Instruction and practice in the skills of wrestling and methods of teaching those skills.
Description of Courses

220. PHYSICAL EDUCATION ACTIVITIES. (1-4) Cr. 3. S.
Prerequisite: 102 or equivalent.
Instruction in the skills and methods of teaching a series of physical education activities.

301. FOOTBALL OFFICIATING. (1-2) Cr. 1 or 2. F.
Rules and practice.

302. BASKETBALL OFFICIATING. (1-2) Cr. 2. S.
Rules and practice.

303. BASEBALL OFFICIATING. (1-2) Cr. 2. S.
Rules and practice.

309. ATHLETIC TRAINING. (3-0) Cr. 3. W.S.
Prerequisite: Zool. 156.
Principles governing conditioning for various sports; diet, sleep, bathing, massage; over-training; prevention and care of injuries.

314, 315, 316, 317. COACHING OF ATHLETIC SPORTS. (3-0) Cr. 3 each. 314: W.; 315: F; 316: W.; 317: S.
314: Football.
315: Basketball.
316: Track.
317: Baseball.
History, rules, theory, coaching methods

318. HISTORY OF PHYSICAL EDUCATION. (3-0) Cr. 3. F.
Evolution of modern physical education, its many activities, its place in the educational pattern of each period

319. ORGANIZATION AND ADMINISTRATION OF INTRAMURAL ATHLETICS. (3-0) Cr. 3. W.
Conduct and direction with special emphasis on place at the secondary level.

384. AN INTRODUCTION TO SUPERVISED RECREATION. (3-0) Cr. 3. F.
An introductory course designed to develop leadership techniques, measure aptitudes, and orient the student in the general area of recreation.

391. PRINCIPLES OF PHYSICAL EDUCATION. (3-0) Cr. 3. F.
Prerequisite: Ed. 204.
Interpretation of objectives of physical education and health education. Analysis of activities in terms of developmental objectives

411. 412, 413. SUPERVISED TEACHING IN PHYSICAL EDUCATION. (0-3 or 6) Cr. 1 or 2. Yr.
Practice with school and college groups.

481. 482, 483. LEADERSHIP IN SUPERVISED RECREATION. (0-3 or 6) Cr. 1 or 2. Yr.
Prerequisite: Open to juniors or seniors preparing in the supervised recreation program for leadership of community groups.

484. SUPERVISED RECREATION PROGRAM DEVELOPMENT. (2-2) Cr. 3. W.
Prerequisite: Open only to senior majors enrolled in the supervised recreation program.
To study the importance of continual development of activities and the breadth of the program in order to meet the needs of specific types of communities.

485. ORGANIZATION AND ADMINISTRATION OF SUPERVISED RECREATION. (3-0) Cr. 3. S.
Prerequisite: Open only to senior major students preparing in the supervised recreation program.
Organizational and administrative procedures in practice in community and industrial programs.

490. SPECIAL PROBLEMS. (Arr.) Cr. Var. F.W.S.
Prerequisite: Open to major students in physical education.
Investigating, analyzing and reporting on a problem in the areas of physical education or supervised recreation selected in conference with instructor.

492. HUMAN RELATIONSHIP ASPECTS OF COACHING. (3-0) Cr. 3. F.
Prerequisite: Senior classification in physical education for men curriculum.
Factors necessary for effective human relations in successful coaching.

493. ORGANIZATION AND ADMINISTRATION. (3-0) Cr. 3. F.
Organization and administration of physical education and athletics. Program for required and elective courses; intramural and interschool athletics.

495. PROGRAM DEVELOPMENT IN PHYSICAL EDUCATION. (2-2) Cr. 3. W.
Prerequisite: Senior classification in physical education for men curriculum.
A study of ideal programs at all school levels and how they are developed to meet changing needs.

496. TESTS AND MEASUREMENT IN PHYSICAL EDUCATION. (2-2) Cr. 3. S.
Prerequisite: Senior classification in physical education for men curriculum, Psych. 440.
Study of 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: Psych. 333.
Application of general educational methods to physical education. Special methods of teaching activities not covered in 314, 315, 316, 317.
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.; Patricia D. Downie, M.S.; Betty A. Keenan, M.A.
Assistant Professors: Madge H. Bowers, B.S.; Patricia D. Downie, M.S.; Betty A. Keenan, M.A.

Opportunities for 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 University Committee on Teacher Education in order to advance to the teacher education program. For the teacher education program, including requirements for teaching certification, see Teacher Education.

The department offers, in addition, a wide selection of activities from which freshmen and sophomores fulfill their six credit 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. Extensive 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.

Freshmen and sophomores are required to enroll in physical education for consecutive quarters, until the six credit requirement is completed.

COURSES PRIMARILY FOR UNDERGRADUATE STUDENTS

Beginning Courses

Aquatics

AQUATICS
101. Beginning Swimming. (0-3) Cr. 1. F.W.S.SS1, SSII.

Rhythmic

RHYTHMIC.
110. Beginning Modern Dance. (0-3) Cr. 1. F.W.S.
117. Folk Dance. (0-2) Cr. 1. F.W.S.
118. American County Dance. (0-2) Cr. 1. F.W.S.
Description of Courses

Team Sports

125. Hockey. (0-3) Cr. 1. F.
126. Volleyball. (0-2) Cr. 1. F.W.S.
127. Basketball. (0-3) Cr. 1. W.
128. Softball. (0-3) Cr. 1. S.

Individual Sports and Activities

130. Beginning Tennis. (0-3) Cr. 1. F.S.SSI.SSI.
133. Beginning Badminton. (0-2) Cr. 1. W.
136. Archery. (0-3) Cr. 1. F.W.S.SSI.
138. Bowling. (0-2) Cr. 1. F.W.S.

Intermediate and Advanced Courses

Aquatics

201. INTERMEDIATE SWIMMING. (0-2) Cr. 1. F.W.S.SSI.SSI.
Prerequisite: A presentable front crawl, elementary backstroke, ability to float and swim in deep water.

202. ADVANCED SWIMMING. (0-2) Cr. 1. F.W.S.SSI.SSI.
Prerequisite: Ability to swim lengths in a good front crawl, back crawl, elementary back stroke, side stroke and breast stroke.

203. LIFE SAVING. (0-3) Cr. 1. F.S.
Prerequisite: Minimum age 16. Ability to swim 220 yards of front crawl, trudgon crawl, double trudgon or trudgon. Surface dive and swim under water, float and tread water.

204. WATER SAFETY INSTRUCTOR. (0-4) Cr. 1. F.W.S.SSI.
Prerequisite: Minimum age 18. Current Senior Life Saving Certificate (advanced swimming course).

205. SYNCHRONIZED SWIMMING. (0-2) Cr. 1. F.W.S.
Prerequisite: Advanced Swimmer as determined by American Red Cross standards, Iowa State University course and pre-liminary testing. Basic techniques in synchronized swimming, figures, stroking, choreography and accompaniment.

Rhythmic

210. MODERN DANCE COMPOSITION. (0-2) Cr. 1. F.W.S.
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.S.
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.

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.

233. INTERMEDIATE BADMINTON. (0-2) Cr. 1. W.
Prerequisite: Completed beginning badminton course on college level or instructor's permission.
325. INTERMEDIATE GYMNASTICS.
(0-3) Cr. 1. S.
Prerequisite: Beginning Gymnastics or permission 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. Introduction of the hook and curve ball releases and technical aspects involved in picking up spares. Organization and administration of competition in bowling.

Elective Courses Open to all Students

326. RECREATIONAL LEADERSHIP.
(3-0) Cr. 3. F.
Prerequisite: 5 credits required physical education.
Theory of play, organization and administration of play centers. Recreational programs studied and planned with leadership experience.

356. CAMPING AND OUTDOOR EDUCATION.
(2-1) Cr. 1. and Cr. 3. S.
Prerequisite: 3 credits required physical education.

Professional Program Courses

150, 151, 152. FUNDAMENTALS OF PHYSICAL EDUCATION ACTIVITIES.
(6-5) Cr. 1 each. F.W.S.

190. INTRODUCTION TO PHYSICAL EDUCATION.
(3-0) Cr. 3. W.
Nature and scope of physical education as a profession with emphasis on the historical development.

250, 251, 252. FUNDAMENTALS OF PHYSICAL EDUCATION ACTIVITIES.
(0-5) Cr. 1 each. F.W.S.

265. FUNDAMENTALS OF MODERN DANCE.
(0-5) Cr. 1. S.
Instruction and practice in the fundamental techniques of modern dance. Emphasis on developing creative skills and basic concepts involved in dance composition.

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, Track and Field. 271: Basketball.

310, 311. DANCE PRODUCTION.
(1-2) Cr. 1 each. F.W.
Prerequisite: 211 or permission of instructor.

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 Balestra attacks.

Upon completion of six credits of physical education, any course not already used for credit or any intermediate and advanced course may be elected from the above activity courses.

An introduction to the background of camping: the camp counselor, the camp program, methods of leadership and the knowledge of camp craft skills. Emphasis on developing the skills of outdoor living.

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.

Principles of dance concert production and performance. 310. Choreography, program planning, costuming, make-up, staging and accompaniment for dance concerts. 311: Work in rehearsing and producing a concert.

385. TECHNIQUES AND METHODS IN SOCIAL, FOLK, AND SQUARE DANCE.
(1-4) Cr. 2. F.
Prerequisite: 118, 265.
Theory and practice of skills involved in executing and teaching, social, folk, and square dance. An analytical study of the rhythmic structure inherent in these dance activities.

386. METHODS OF TEACHING MODERN DANCE.
(2-3) Cr. 3. S.
Prerequisite: 310, 311, 380, 385.
General methods for teaching modern dance, solo composition, and group choreography. Information on accompaniment for dance.

390, 391, 392. EDUCATIONAL BASES OF PHYSICAL EDUCATION.
(4-5) Cr. 2-6 each. F.W.S.
Prerequisite: 150, 151, 152, 190, 250, 251, 252, 265, Ed. 204.
Philosophy, curriculum, general methods, organization and administration of physical education programs. Specific methods of teaching sports, swimming, and modern dance.

417. SUPERVISED TEACHING IN PHYSICAL EDUCATION.
Cr. 4 to 12. F.W.S.
Prerequisite: 385, 392, Ed. 305.
 Supervised teaching in the elementary and/or secondary schools.
Description of Courses

452. EVALUATION IN PHYSICAL EDUCATION. (3-3) Cr. 4. W.
Prerequisite: Senior standing.
Survey and evaluation of tests and measurement procedures used in the field of physical education.

470. ELEMENTARY SCHOOL PHYSICAL EDUCATION. (2-0) Cr. 2. F.W.S.SSI.
Prerequisite: C. D. 337 or P.E. 390.
Objectives and scope of physical education in the elementary school with emphasis on program planning and motor skills development.

471. ELEMENTARY SCHOOL PHYSICAL EDUCATION TEACHING METHODS. (0-3) Cr. 1. F.W.S.SSI.
Prerequisite: Credit or classification in 470.
Methods of teaching dance, games and sports in the elementary schools. Open to child development-elementary education majors and physical education secondary education majors.

472. CREATIVE RHYTHMIC ACTIVITIES FOR ELEMENTARY SCHOOL CHILDREN. (1-2) Cr. 2. W.
Prerequisite: Credit or classification in 470.
Methods of teaching creative rhythmic activities in the elementary grades. Emphasis on movement exploration and various dance forms. Open to physical education majors in K-12 certification program.

473. GAMES AND ACTIVITIES FOR ELEMENTARY SCHOOL CHILDREN. (1-2) Cr. 2. S.
Prerequisite: Credit or classification in 470.
Methods of teaching games and activities in the elementary schools. Emphasis on games, self-testing and gymnastics skills, fitness and sports for lower and upper elementary grades. Open to physical education majors in K-12 certification program.

474. SEMINAR IN PHYSICAL EDUCATION. (2-0) Cr. 2. S.
Prerequisite: Senior standing.

COURSES PRIMARILY FOR GRADUATE STUDENTS, major or minor, open to qualified undergraduates

590W. SPECIAL TOPICS. (Ed. 590W) See Education.
Opportunities for 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.

The undergraduate curriculum in sciences and humanities, major in physics, offers training suitable for students planning to enter secondary school teaching, to begin work in research or development laboratories, or to continue their studies in graduate school. In general the needs of those expecting to terminate formal study with the B.S. degree are best served by the standard program outlined below. Students who expect to undertake graduate study in pursuit of higher degrees may also follow this standard program but will usually find more desirable the second program below, which includes accelerated and enriched course work during the junior and senior years.

Undergraduate majors in this department in the standard program usually will complete the following courses: 131, 132, 133, 134, 135, 136, 231, 232, 233, 234, 235, 236, (221, 222, 223 acceptable in place of 131 through 236); 304, 310, 311, 354, 355, 394, (generally scheduled during the junior year); 411, 421, 422, 423, 494, 495, 496, 499 (generally scheduled during the senior year). Modifications in this program can be made to accommodate required education courses for those preparing to teach. Students in the enriched program usually will include 131, 132, 133, 134, 135, 136, 231, 232, 233, 234, 235, 236; 304, 310, 311, 361, 362, 363, 394 (generally scheduled during the junior year); 411, 481, 482, 483, 490, 494, 495, 496, 499 (generally scheduled during the senior year). As supporting work undergraduate majors find the following courses desirable: Math. 101, 102, 110, 111, 112, 213, 321, 322, 404, 410, 411, 414, 415, 416; Chem. 101, 102, 103, or 107, 108. Work equivalent to Math. 101 and 102 should be completed in high school if possible, so that the entering student can begin Math. 110 at once.

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.
Opportunities for Graduate Study

The department offers work leading to the degrees Master of Science and Doctor of Philosophy in physics and minor work to students taking major work in other departments. Facilities of the department and of the Institute for Atomic Research, with which it is closely associated, permit theoretical and experimental investigations in many fields, including solid state physics, nuclear physics, high energy physics, low temperature physics and astrophysics.

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 considers that the following undergraduate courses form suitable supporting work for graduate students majoring in other areas: 304, 344, 345, 346, 354, 355, 394, 411, 421, 422, 423, 490, 494, 495, 496.

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.

### COURSES PRIMARILY FOR UNDERGRADUATE STUDENTS

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
<th>Prerequisites</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>106</td>
<td>ELEMENTARY PHYSICS</td>
<td>(4-2) Cr. 4</td>
<td>Math 101C</td>
<td>Primarily for home economics students. Topics in mechanics, heat, electricity, and light.</td>
</tr>
<tr>
<td>111, 112, 113</td>
<td>GENERAL PHYSICS</td>
<td>(2-4) Cr. 4 each</td>
<td>Math 101C</td>
<td>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.</td>
</tr>
<tr>
<td>131, 132, 133</td>
<td>GENERAL PHYSICS</td>
<td>(3-0) Cr. 3 each</td>
<td>Math 101C</td>
<td>For students majoring in physics. Mechanics, heat, wave motion and sound.</td>
</tr>
<tr>
<td>151, 152, 153</td>
<td>INTRODUCTION TO ASTRONOMY</td>
<td>(2-0) Cr. 2 each</td>
<td>Math 101C</td>
<td>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.</td>
</tr>
<tr>
<td>221, 222, 223</td>
<td>GENERAL PHYSICS</td>
<td>(4-2) Cr. 6 each</td>
<td>Math 101C</td>
<td>For engineering students and others desiring a rigorous one-year course in general physics. Topics in mechanics, heat, sound, light, electricity and magnetism.</td>
</tr>
<tr>
<td>231, 232, 233</td>
<td>GENERAL PHYSICS</td>
<td>(3-0) Cr. 3 each</td>
<td>Math 101C</td>
<td>For students majoring in physics. 231: Electricity and magnetism. 232: Electricity and magnetism, geometrical and physical optics. 233: Modern physics.</td>
</tr>
<tr>
<td>301, 302, 303</td>
<td>MODERN PHYSICS</td>
<td>(3-0) Cr. 3 each</td>
<td>Math 101C</td>
<td>For students majoring in physics. 301: Electricity and magnetism, quantum mechanics, atomic spectra, X-rays, solid state physics and nuclear physics.</td>
</tr>
<tr>
<td>304</td>
<td>THERMODYNAMICS</td>
<td>(3-0) Cr. 3</td>
<td>Math 101C</td>
<td>Concepts of temperature, entropy and other characteristic thermodynamic functions; laws of thermodynamics and applications to macroscopic properties of matter.</td>
</tr>
<tr>
<td>310</td>
<td>UNDERGRADUATE ELECTRONICS LABORATORY</td>
<td>(0-6) Cr. 3</td>
<td>Math 101C</td>
<td>Basic properties of electronic components, amplifiers and pulse circuits, feedback.</td>
</tr>
<tr>
<td>311</td>
<td>ADVANCED UNDERGRADUATE LABORATORY</td>
<td>(0-6) Cr. 3 each</td>
<td>Math 101C</td>
<td>Experiments in classical and modern physics. Emphasis is placed upon planning of experimental procedures.</td>
</tr>
</tbody>
</table>
344. 345. GENERAL ASTRONOMY I, II. (3-0) Cr. 3 each. F.W.
Prerequisite: 223 or 233; or 113 and permission of instructor.
344: Celestial coordinates, time, optical and radio telescopes, the moon, solar and lunar eclipses, celestial mechanics, artificial earth satellites, and the solar system. 345: The stars, star clusters, binary and variable stars, radio astronomy, stellar evolution, galactic and extragalactic systems.

346. INTRODUCTION TO ASTROPHYSICS. (3-0) Cr. 3. S.
Prerequisite: 345.

354, 355. INTERMEDIATE MECHANICS. (3-0) Cr. 3 each. W.S.
Prerequisite: 223 or 233, Math. 213, 410.
Newtonian mechanics: dynamics of particles, systems of particles, and rigid bodies. Lagrange's equations.

361, 362. CLASSICAL MECHANICS. (3-0) Cr. 3 each. F.
Prerequisite: 223 or 233, Math. 213, 410.
For physics majors in the enriched program. 361: Newtonian mechanics. 362: Lagrangian and Hamiltonian mechanics, relativity.

363. INTRODUCTORY QUANTUM MECHANICS. (3-0) Cr. 3. S.
Prerequisite: 362, Math. 322.
The concepts and elementary applications of quantum mechanics.

371, 372, 373. IDEAS OF PHYSICS. (3-0) Cr. 3 each. Yr.
Prerequisite: Enrollment in the University honors program or permission of instructor.
A presentation to non-physicists 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 or 233, Math. 213.

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 are selected from fields of current research interest in physics. Emphasis is placed on preparation of students for independent research.

421, 422, 423. INTERMEDIATE MODERN PHYSICS. (3-0) Cr. 3 each. Yr.
Prerequisite: 223 or 233, Math. 322, 410. 421: Special theory of relativity. Planck's quantum hypothesis and its first applications: black-body radiation, photoelectric effect, Debye theory of specific heat. 422: Introductory quantum mechanics. The Schrödinger equation and elementary applications, the hydrogen atom, electron spin and atomic spectra, Pauli exclusion principle and the periodic table. 423: X-rays, elementary theory of solids, basic properties of nuclei, natural radioactivity, elementary particles.

450. UNDERGRADUATE RESEARCH. Cr. 1 to 6 each time elected. F.W.S.S.
Prerequisite: Permission of instructor.
Experimental or theoretical research under staff supervision.

481. STATISTICAL PHYSICS. (3-0) Cr. 3. F.
Prerequisite: 304, 363 or equivalent. Math. 322, 410.
For physics majors in the enriched program. Probability, kinetic theory and statistical mechanics.

482. ATOMIC AND SOLID STATE PHYSICS. (3-0) Cr. 3. W.
Prerequisite: 481.
Introduction to the quantum theory of atomic structure, and to the transport properties, magnetic properties, and band theory of solids.

483. NUCLEAR PHYSICS. (3-0) Cr. 3. S.
Prerequisite: 482.

490. SPECIAL TOPICS. Cr. 1 to 4 each time elected. F.W.S.S.
Prerequisite: Permission of instructor.

494, 495. ELECTRICITY AND MAGNETISM. (3-0) Cr. 3 each. F.W.
Prerequisite: 223 or 233, 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 are reported and discussed by members of the class.
COURSES FOR GRADUATE STUDENTS, major or minor, open to qualified undergraduates

501, 502. STELLAR INTERIORS.
(3-0) Cr. 3 each. Alt. F.W. Offered 1967-1968.
Prerequisite: 304; 423 or 483.

504, 505. STELLAR ATMOSPHERES.
(3-0) Cr. 3 each. Alt. F.W. Offered 1967-1968.
Prerequisite: 304; 423 or 483.

507. INTERSTELLAR MATTER.
(3-0) Cr. 3. Alt. S. Offered 1968.
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: 303 or 423.
Primarily for graduate students not majoring in physics. Physical properties of solids, with special emphasis on semiconductors and metals. Crystal symmetry; ionic, covalent and metallic bonding; free electron model; band theory of solids; Fermi surface; transport properties; superconductivity; ferromagnetism; physics of transistors, semiconducting lasers, and other solid state applications.

524, 525. NUCLEAR PHYSICS.
(3-0) Cr. 3 each. F.W.
Prerequisite: 423 or 483.
Nuclear masses, moments, binding energies, systematics of stable nuclei, isotopic spin, nucleon-nucleon interactions, alpha and beta decay, nuclear reactions, scattering, electromagnetic and electron-nuclear interactions, basic elements of nuclear models.

526. FUNDAMENTAL PARTICLES.
(3-0) Cr. 3. S.
Prerequisite: 525.
Phenomenological account of fundamental particles, strong interactions and their selection rules, weak interactions and their selection rules, resonances.

531, 532. THERMODYNAMICS, STATISTICAL MECHANICS AND KINETIC THEORY.

COURSES FOR GRADUATE STUDENTS, major or minor

611, 612, 613. QUANTUM THEORY OF SOLIDS.
(3-0) Cr. 3 each. Yr.
Prerequisite: 593.
Topics include X-ray and neutron diffraction in crystals; phonon and electron spectra in metals, semi-conductors and insulators; calculations of band structure from atomic data; the Fermi surface; equilibrium and transport properties of solids, superconductivity, ferromagnetism and nuclear magnetic resonance.
624, 625. NUCLEAR THEORY.
(3-0) Cr. 3 each. F.W.
Prerequisite: 525, 593.
Nuclear models many-particle shell models, Nilsson's model, collective effects, unified models, nuclear superconductivity. Nuclear reactions, compound nucleus and statistical theories, R-matrix and dispersion theory, optical model, direct interactions. Alpha and beta decay and fission.

640. SPECIAL TOPICS.
F.W.S.
Prerequisite: Permission of instructor.

650. ADVANCED SEMINAR.
(1-0) Cr. 1 each time elected. F.W.S.

660. ADVANCED TOPICS IN PHYSICS.
Cr. 1 to 3 each time elected. F.W.S.

674, 675, 676. APPLICATION OF GROUP THEORY TO PHYSICS. (Math. 674, 675, 676).
(3-0) Cr. 3 each. Alt. Yrs. Offered 1968-1969.
Prerequisite: 423 or 482.
671: Role of group theory in physics, theory of finite groups, group representations and group characters, point groups, with applications to molecular and solid state physics, space groups and "little group" theory with applications to solid state physics. 672: Continuous groups, the rotation group and angular momentum theory, applications to angular momentum. 673: The Galilean group, the Lorentz group and the Poincare group, space inversion and time reversal, application to relativistic quantum mechanics. Groups related to the classification of atomic and nuclear energy levels and the classification of fundamental particles.

681, 682, 683. QUANTUM MECHANICS.
(Math. 681, 682, 683).
(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.

POULTRY SCIENCE

Richard H. Forsythe, Ph.D., Head 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 W. Marion, Ph.D.

Assistant Professors: Donald L. Miller, Ph.D.; William J. Owings, Ph.D.

Opportunities for 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 students may select, in 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.

Opportunities for 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

101. INTRODUCTION TO POULTRY SCIENCE. (3-0) Cr. 3. F.W.
Principles and practices of poultry industry. Introduction to the production, processing and marketing of eggs and poultry. Study of the breeding, feeding and management practices as they affect production economics and product quality.

110. TECHNICAL LECTURE. (1-0) Cr. R.F.
Opportunities in poultry science.

301. POULTRY SCIENCE TECHNIQUES. (1-3) Cr. 2. F.
Prerequisite: 101 or 365.
A laboratory course designed to supplement 101 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 1969.
Prerequisite: 101, Zool. 234.
Problems in hatchery management, including the principles of artificial incubation. Trips will be made 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.SSI.
Prerequisite: Junior or senior classification. Practical feeding and management of poultry flocks. Operational study of commercial poultry farms, including production and marketing practices.

401. MEAT AND EGG TECHNOLOGY. (3-3) Cr. 4. F.
Prerequisite: Bact. 304.

402. POULTRY BREEDING. (3-0) Cr. 3. Alt. S. Offered 1968.
Prerequisite: Gen. 301.
Inheritance of egg production, egg size, hatch-ability, body size, viability and plumage color; methods of poultry breeding.

403. TURKEY PRODUCTION. (2-3) Cr. 3. Alt. W. Offered 1969.
Prerequisite: 101, 301.
Development of the turkey industry and the commercial production of hatching eggs, pouls and mature stock. Trips to nearby farms.

404. POULTRY NUTRITION. (3-2) Cr. 4. F.
Prerequisite: An. Sci. 318.
Practical aspects of poultry nutrition. Ration formulation, mixing and feeding tests. Feeding programs and requirement at different ages.

490. SPECIAL PROBLEMS.
Cr. 1 to 3. Yr.
H. Honors Program.
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.
### COURSE PRIMARILY FOR GRADUATE STUDENTS, major or minor, open to qualified undergraduates

590. SPECIAL TOPICS.
Cr. arr. F.W.S. Forsythe.

### COURSES FOR GRADUATE STUDENTS, major or minor

601. ADVANCED POULTRY BREEDING.
(3-0) Cr. 3. Alt. F. Offered 1968.
Prerequisite: 402. Nordskog.
Survey of poultry genetics. Application of systems of breeding to poultry, including inbreeding, outbreeding, hybridization and methods of selection.

602. ADVANCED MEAT AND EGG TECHNOLOGY.
(3-0) Cr. 3. Alt. S. Offered 1968.
Prerequisite: 401. Marion.
Qualitative and quantitative techniques for studying composition of meat and eggs. Involvement of muscle components in meat tenderness, and in other palatability factors. Functional properties of egg components. Product deterioration including physical, chemical and microbiological.

603. SEMINAR IN ANIMAL NUTRITION AND MEATS.

605. METHODS AND TECHNIQUES IN ANIMAL NUTRITION EXPERIMENTATION.

614. ADVANCED POULTRY NUTRITION.
(3-2) Cr. 4. Alt. W. Offered 1968.
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.
D. Poultry Products Technology. Forsythe, Marion.

### PSYCHOLOGY

Wilbur L. Layton, Ph.D., Head of Department


**Associate Professors:** Frederick G. Brown, Ph.D.; George G. Karas, Ph.D.; Edwin C. Lewis, Ph.D.; John R. Schuck, Ph.D.; Donald H. Schuster, Ph.D.; James A. Walsh, Ph.D.; Roy E. Warman, Ph.D.

**Assistant Professors:** Wayne H. Bartz, Ph.D.; David C. Edwards, Ph.D.; John P. Hartzell, B.D.; Aaron Lowin, Ph.D.; Daniel M. McMillen, Ph.D.; David H. Mills, Ph.D.; Raymond E. Moore, Ph.D.; Ronald H. Peters, Ph.D.; Charles A. Poe, Ph.D.; Lillian C. Schwenk, M.S.; Donald G. Zytowski, Ed.D.

### Opportunities for 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, psych­
ometricians and personnel technicians. Many positions require at least the Master of
Science degree.

Undergraduate majors in this department should include the following courses in
their programs: 201, 202, 230, 301, 302, 380, 440, 460.
As supporting work, undergraduate majors are urged to take the following courses:
Math. 101, 104; Stat. 201; Phys. 111, 112, 113, or Chem. 101, 102, 103; Soc. 134;
Zool. 303, 355; Gen. 301 or 400; Phil. 370, 480, 481. The exact program of courses
will be developed by the student and his major adviser.

For students desiring a minor in personnel psychology, 440, 450, 451, 550 and 551
are recommended.

The following courses appropriately can be taken by non-majors with primary in­

The psychology requirement for an Iowa professional teaching certificate will be met
by 101, 230 and 333.

270, 370 and 371, plus 5 hours from 499, 570, 571 or 599 and Ed. 550 will meet
the minimum requirements of the State Department of Public Instruction for the teaching
of driver education and safety.

Several undergraduate courses provide students with the opportunity to gain first­
hand experience with psychological research through participation as subjects in exper­
imentation 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.

Opportunities for 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
a recognized curriculum substantially equivalent to one of the undergraduate curricula
of Iowa State University. Prerequisite to admission is at least 15 credits of basic psychology,
which normally should include a laboratory course, a quantitative or methods course,
a social psychology course and a course with developmental emphasis.

Open to graduate students for minor only: 430, 436, 440, 441, 451, 460.

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COURSES FOR NONCOLLEGIATE STUDENTS

10. ACADEMIC LEARNING SKILLS.
    (2-2) Cr. 0. F.W.S.S.
    Efficient methods of studying and reading.

78. AUTOMOBILE DRIVING.
    (0-2) Cr. 0. F.W.S.S.
    For those learning to drive an automobile.
    See Fees and Expenses.
COURSES PRIMARILY FOR UNDERGRADUATE STUDENTS

101. GENERAL PSYCHOLOGY. (3-0) Cr. 3. F.W.S.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.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.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.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.

250. PSYCHOLOGY OF SALES AND ADVERTISING. (3-0) Cr. 3. W.
Prerequisite: 101.
Psychological principles underlying sound salesmanship and advertising. Selection and training of salesmen in effective selling. Research on and testing of advertising. Attention, memory, readability, believability.

270. PROBLEMS OF HUMAN CONSERVATION. (3-0) Cr. 3. F.
Prerequisite: 101.
Survey of highway, industrial, farm and home safety and safety organizations. Principles of accident prevention; individual and group responsibilities.

301, 302. EXPERIMENTAL PSYCHOLOGY. (1-4) Cr. 3 each. F.W.S.
Prerequisite: 201, 202. Stat. 201.
Research methodology in psychology. The scientific study of human behavior is emphasized in psychophysics, perception, sensory processes, motivation and learning. Research techniques applied in laboratory setting.

333. EDUCATIONAL PSYCHOLOGY. (3-0) Cr. 3. F.W.S.S.S.
Prerequisite: 230.
Emphasis on human learning. Consideration of concepts of readiness, individual differences, motivation, retention, transfer, concept development, reasoning, mental health, and measurement as related to learning. Psychological principles of teaching-learning technology are examined.

370. THEORY AND PRINCIPLES OF DRIVER EDUCATION. (3-2) Cr. 4. W.
Prerequisite: 270. Iowa driver's license, permission of instructor.
Source materials, methods, policies and procedures, and psychological aspects of driver education; techniques including psychophysical measurement and interpretation.

371. PRACTICES OF DRIVER EDUCATION. Cr. 1 to 3 each time elected, total no more than 4. F.W.S.S.S.
Prerequisite: 370. 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.

380, 381. SOCIAL PSYCHOLOGY. (3-0) Cr. 3. F.W.
Prerequisite: 380: 201; 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.

430. PSYCHOLOGY OF ADOLESCENCE. (3-0) Cr. 3. F.W.S.S.S.
Prerequisite: 230.
Developmental characteristics of the adolescent; emphasis upon typical behavior at this developmental period; implications for education and guidance of adolescents.

436. PSYCHOLOGY OF EXCEPTIONAL CHILDREN. (3-0) Cr. 3. W.
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.
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. OPINION, ATTITUDE AND MOTIVATION ANALYSIS. (3-0) Cr. 3. S.
Prerequisite: 201, Stat. 201.
Genesis of opinions, attitudes and motives; construction of measuring devices; problems of sampling, scaling and analysis; implications and applications.

450. INDUSTRIAL PSYCHOLOGY I. (3-0) Cr. 3. F.S.
Prerequisite: 401.
Content and methods of industrial psychology with emphasis on differential 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 and modifying employee performance.
460. PSYCHOLOGY OF ADJUSTMENT. (4-0) Cr. 4. F.W.S.S.
Prerequisite: 9 credits in psychology.
Normal and abnormal modes of adjustment
Emphasis on motivation and learning in development of adjustment patterns
Field trips

499. SPECIAL PROBLEMS.
Cr. 1 to 4 each time elected. F.W.S.S.1.
Prerequisite: 6 credits in Psych., permission of instructor.
A. Historical, Systematic, Theoretical

COURSES PRIMARILY FOR GRADUATE STUDENTS, major or minor, open to qualified undergraduates

500. ENGINEERING PSYCHOLOGY. (I.E. 500).
(3-0) Cr. 3. Alt. F. Offered 1967.
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. ADVANCED EXPERIMENTAL PSYCHOLOGY.
501: (3-0) Cr. 3; 502, 503: (3-2) Cr. 4 each Yr.
Prerequisite: 501: 15 credits in Psych. Including 302 or equivalent; 502: 501; 503: 502.
Edwards, Karas, Schuck.
501. Psychological research methods with emphasis on the experimental method and experimental techniques, psychological literature.
502. Advanced experimental investigation of sensory processes, perception and psycho-physiology. Individual research project required. Research techniques specific to experimentation on the learning process.
Empirically derived concepts in laboratory investigation of learning.

505. PSYCHOMETRICS. (Stat. 505) See Statistics.

510. COMPARATIVE PSYCHOLOGY. (3-0) Cr. 3. Alt. F. Offered 1968.
Prerequisite: 302. Karas.
Concepts and techniques used in the experimental analysis of animal behavior.
Emphasis on mammalian behavior.

515. 516. PHYSIOLOGICAL PSYCHOLOGY. (3-0) Cr. 3. Alt. W.S. Offered 1968-69.
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 Psych. 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: 201, 440. Zytołowski.
Theories of vocational behavior, including vocational development and choice, and their relationships to job satisfaction and job performance.

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 1968.
Prerequisite: 15 credits in Psych. 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 1969. SS.
Prerequisite: 9 credits in Psych., 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 1969. SS.
Prerequisite: 501, 533. Lewis.
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 1969.
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 Psych., including 440. Layton.
Theoretical and instrumental definition of variables. Reliability and validity of measurements.
541. INDIVIDUAL TESTING. (3-0) Cr. 3. S.S.S. 
Prerequisite: 440, permission of instructor. 
Hannum. 
Theory of individual mental testing. Development and techniques of administering, scoring, and interpreting individually administered tests. Emphasis on Binet and Wechsler tests.

545. DIFFERENTIAL PSYCHOLOGY. (2-0) Cr. 2. S. 
Prerequisite: 440. MacKinney. 

550. ADVANCED INDUSTRIAL PSYCHOLOGY I. (3-0) Cr. 3. Alt. S. Offered 1968. 
Prerequisite: 440 or permission of instructor. 
MacKinney. 

551. ADVANCED INDUSTRIAL PSYCHOLOGY II. (3-0) Cr. 3. Alt. S. Offered 1969. 
Methods, theory and practice of industrial psychology, with emphasis on behavioral research in industrial settings.

560, 561, 562. PSYCHOLOGY OF PERSONALITY. (3-0) Cr. 3. Yr. 
Prerequisite: 460 or graduate standing. Mills, Moore. 

570. ADMINISTRATION AND SUPERVISION OF HUMAN CONSERVATION AND ACCIDENT PREVENTION PROGRAMS. (3-0) Cr. 3. S. 
Prerequisite: 270, 370. 
Effective methods of developing the background and motivation essential to accident prevention at various educational levels.

571. SEMINAR: PSYCHOLOGY OF SAFETY. (2-0) Cr. 1. S.S.S. 
Prerequisite: 9 credits in Psych. and Ed. permission of instructor. 
Review of literature in field of safety. Roundtable discussions with state and national safety experts and public officials.

580. ADVANCED SOCIAL PSYCHOLOGY. (3-0) Cr. 3. F.S.S. 
Prerequisite: 9 credits in Psych. including 380. Lowin. 
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 hours in psychology, including 380. Lowin. 
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 Psych., permission of instructor. 
A. Historical, Systematic. Theoretical. 
B. Safety. 
C. Advertising and Sales. 
D. Genetic and Geriatric. 
E. Experimental. 
F. Educational and Learning. 
G. Individual Differences and Psychometrics. 
H. Honors. 
I. Clinical and Abnormal. 
J. Guidance, Personnel, Counseling. 
K. Industrial. 
L. Exceptional Children. 
M. School Psychology. 
N. Social.

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. 
603. Contemporary theories in psychology. Developmental, social and personality.

604. THEORIES OF LEARNING. (3-0) Cr. 3. F. 
Prerequisite: 503. Edwards. 
Examination of the major theories of learning and of the experimental evidence for each.

605. PSYCHOLOGY OF MOTIVATION. (3-0) Cr. 3. W. 
Prerequisite: 503. Edwards. 
An examination of the major research findings and theoretical concepts in the psychology of motivation.

620. PSYCHOLOGICAL COUNSELING. (2-2) Cr. 3. S.S.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.
Description of Courses

636. SCHOOL PSYCHOLOGY.
(1 to 3-0) Cr. 1 to 3. F.W.S.
Prerequisite: Enrollment in school psychology training program, permission of instructor. Charles.
The practice of school psychology; examination of the duties, responsibilities, ethics and problems of the profession.

691. PRACTICUM IN PSYCHOLOGY.
(As Arranged) Cr. 1 to 4 each time elected. F.W.S.S.
Prerequisite: Permission of instructor. Graduate staff.
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.

690. SEMINAR IN SPECIAL AREAS OF PSYCHOLOGY.
(1 to 3-0) Cr. 1 to 3 each time elected. Offered when demand warrants.
Prerequisite: Graduate standing. Graduate staff.

699. RESEARCH.
Graduate staff.

SOCIOTOLOGY AND ANTHROPOLOGY

William F. Kenkel, Ph.D., Head of Department

Professors: Ward W. Bauder, Ph.D.; George M. Beal, Ph.D.; Joe M. Bohlen, Ph.D.; Dorothy Lee, Ph.D.; Walter A. Lunden, Ph.D.; Margaret C. Warning, Ph.D.

Associate Professors: Harry Cohen, Ph.D.; Gerald E. Klonglan, Ph.D.; Ronald C. Powers, Ph.D.; William H. Stacy, Ph.D.


Opportunities for Undergraduate Study

Sociology is concerned with the nature and workings of group life. Courses are built around selected group functions, institutions, and problems with the objectives of providing (1) information gained through research about group life, (2) insight into the "why" of group behavior and (3) techniques for studying social situations and problems.

A major in sociology prepares a student for a variety of occupational fields, among which are (1) positions in private, public welfare, and group work 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 organizations. The facilities of the University provide unusual opportunities for apprenticeship in social welfare and research in industrial relations, population, family, ethnic and intergroup relations, community, anthropology, social problems, etc. Qualified students are encouraged to pursue graduate study in sociology, rural sociology, anthropology or social work, since the more responsible positions require advanced degrees.

Undergraduate students with majors in sociology usually include the following courses in their programs: 134, 135, 202, 218, 301, 401, 402, 445, and 18 additional hours in sociology courses.

In addition to the basic courses for all majors in sociology, fields of specialization are represented by the following course offerings:

3. Industrial sociology: 380, 410, 480, 486, 570.
6. Rural sociology: 200, 390, 391, 393.
The 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.

Program in Anthropology. Anthropology is the study of man, culturally and biologically, throughout time and space. Within this field there are two areas of concentration: (1) Cultural anthropology, which includes the disciplines of social anthropology, archaeology, and anthropological linguistics and (2) physical anthropology.

Undergraduate majors specializing in anthropology will include in their program certain of the departmental core requirements plus additional courses in anthropology and sociology.

Opportunities for Graduate Study

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.

Prerequisite to major graduate work in the department is the completion of undergraduate work in economics, mathematics, statistics, sociology and other social science and technical subjects, substantially equivalent to that required of undergraduate students majoring in sociology or rural sociology at this institution.

The foreign language requirement for the degree Master of Science may be waived upon recommendation of the department head.

Courses open to graduate students for minor credit only: 391, 393, 401, 402, 410, 420, 421, 422, 424, 425, 445, 450, 464, 480, 485, 486, 488.

Courses in Sociology

COURSES PRIMARILY FOR UNDERGRADUATE STUDENTS

134. INTRODUCTION TO SOCIOLOGY. (3-0) Cr. 3. F.W.S.SSI,SSI11.
   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.SSI168, SS169.
   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.
   Prerequisite: 134 or 200.
   Major sociological concepts; elementary sociological theories and models.

300. RACE AND MINORITY GROUP RELATIONS. (3-0) Cr. 3. W.
   Prerequisite: 134 or 200 or 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.
   Prerequisite: 202.
   Introduction to advanced principles; analysis of concepts and propositions.

305. SOCIAL INTERACTION. (3-0) Cr. 3. F.S.SSI168, SS169.
   Prerequisite: 202.
   Dynamics of social relations; analysis of human behavior in group situations.

319. COURTSHIP AND MARRIAGE. (3-0) Cr. 3. F.W.S.SSI168, SS169.
   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. (3-0) Cr. 3. S.SSI168, SS169.
   Prerequisite: 134.
   Social status and social class; analysis of stratification systems in the United States; social status and behavior differences; social mobility.

335. CRIMINOLOGY. (3-0) Cr. 3. F.
   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.
Description of Courses

336. JUVENILE DELINQUENCY. (3-0) Cr. 3. W.S.
Prerequisite: 134.
Sociological nature and extent of delinquency; administration of juvenile courts, institutional treatment, probation and parole; field trips and interviews.

337. CORRECTIONAL INSTITUTIONS. (3-0) Cr. 3. S.
Prerequisite: 336.
Analysis of organization and administration of correctional institutions. One-week field trip to an assigned institution.

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.S.
Prerequisite: 134.
Formal and informal group aspects of business and industrial organizations; group aspects of personnel administration and worker adjustment.

390. SOCIOLOGY OF RURAL LIFE. (3-0) Cr. 3. W.
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.

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.
Prerequisite: 301.
Analysis of major contemporary sociological theories.

402. RESEARCH METHODS IN SOCIOLOGY. (3-0) Cr. 3. F.
Prerequisite: 301.
Research design, field procedures and analysis of data.

410. SOCIOLOGY OF CITY LIFE. (3-0) Cr. 3. F.S.SS168, SS169.
Prerequisite: 134 or 200.
Growth, structure, and functions of the city; urban-social relations.

445. POPULATION STUDIES. (3-0) Cr. 3. W.SS168, SS169.
Prerequisite: 201.
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.

461. FIELDS OF SOCIAL WORK. (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.

464. COMMUNITY ACTION. (3-0) Cr. 3. W.SSI.
Prerequisite: 202.
Community analysis of mobilization and organization of community resources for social action; field studies.

480. INDUSTRIAL SOCIOLOGY. (3-0) Cr. 3. F.
Prerequisite: 202 or 380.
Social organization of industrial systems, social implications of bureaucracy and technological change.

485. SOCIOLOGY OF THE FAMILY. (3-0) Cr. 3. S.
Prerequisite: 202.
Analysis of the family as a group; cultural influences, group processes and institutional aspects.

486. LEADERSHIP AND SOCIAL INTERACTION. (3-0) Cr. 3. W.SSI68, SS1169.
Prerequisite: 202 or 305.
Genesis of leadership; leader-follower roles and leader types in modern society; case studies of contemporary theories.

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 and 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.
F. Laborrelations.
H. Honors Program.

* 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

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: 503.
Contemporary theories in sociology Social system analysis. Conflict-dialectic analysis Eclectic formulations. Deductive, axiomatic theories

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 1968.
Prerequisite: 202, 305 or Psych. 380.
Analytic treatment of diffuse, affective interpersonal relations; development of such primary relations in a variety of social situations, importance of primary relations in identity development and maintenance of social organizations

570. SOCIAL ORDER AND SOCIAL CONFLICT.
(Govt. 570) (3-0) Cr. 3. W.
Prerequisite: 9 credits in Soc., 9 credits in Govt. or Hist.
Sociological analysis of power, power structure, mass society, and elite formation, conflict management within and between nations

590. SOCIAL ORGANIZATION.
(3-0) Cr. 3. Alt. W. Offered 1969.
Prerequisite: 9 credits in sociology.
Theories of social organization; group structure and process as frames of reference. Differentiating factors affecting the structure of society; classification of basic social forms.

599. SPECIAL TOPICS.
Cr. 1 to 5. F.W.S.
Prerequisite: 15 credits in Soc., senior or graduate classification.
A. General Sociology.
B. Social Welfare.
C. Industrial Sociology.
D. Family Sociology.
E. R Rural Sociology.
S Diffusion of Agricultural Ideas.
T. Cross-Cultural Transfer of Knowledge.
V. Rural Social Adjustment.
W. Social Action.

COURSES FOR GRADUATE STUDENTS, major or minor

685. SOCIAL CHANGE AND THE FAMILY.
(3-0) Cr. 3. W.
Prerequisite: 485 plus 9 graduate credits in sociology.
Changes in the family institution as societies evolve from agricultural to urban: adaptive function of the family.

698. ADVANCED TOPICS IN SOCIOLOGY.
(3-0) Cr. 3 each.
I. General:
A. Social Theory. F.
B. Social Institutions Alt S. Offered 1969.
C. Population. Alt S. Offered 1969
H. Research Methods, 1 & 2 F.W.

Courses in Anthropology

COURSES PRIMARILY FOR UNDERGRADUATE STUDENTS

218. INTRODUCTION TO CULTURAL ANTHROPOLOGY.
(3-0) Cr. 3. F.W.S.SS168, SS169.
Anthropological concepts and techniques for understanding world cultural similarities and differences; universal aspects of human experience, including the family, economic, political, and religious systems examined in cross-cultural perspective.

2. Family:

3. Rural:
P. Current Rural Research. F.W.
R Development of Rural Research Alt. W. Offered 1968.

699. RESEARCH.

* Offered by the College of Agriculture. Sociology courses not marked by an asterisk are offered by the College of Sciences and Humanities.
219. INTRODUCTION TO PHYSICAL ANTHROPOLOGY.
(3-0) Cr. 3. F.
Human origins, fossil man, differentiation into races; physical anthropology of the living; interplay of biological and cultural factors in human condition.

220. INTRODUCTION TO ARCHAEOLOGY.
(3-0) Cr. 3. W.
Origin and development of culture from Paleolithic assemblages through the beginnings of civilization; world prehistory by major culture areas.

221. PRIMITIVE CULTURES OF THE WORLD.
(3-0) Cr. 3. S.
Prerequisite: 218.
Primitive and folk cultures on a worldwide basis; cultural continuity from the ethnographic present to transitional folk societies. Representative groups within a framework of culture areas.

222. THE AMERICAN INDIAN.
(3-0) Cr. 3. W.
Prerequisite: 3 credits in anthropology.
Origin and distribution of native populations in North and South America; survey of cultural patterns of various ethnic groups; problems of adaptation subsequent to European contact.

223. THE PEOPLES OF MIDDLE AND SOUTH AMERICA.
(3-0) Cr. 3. F.
Prerequisite: 3 credits in anthropology.
Cultural backgrounds of middle and South American groups; historical and present economic, social, and religious systems of Indian and Mestizo groups in rural regions; processes of acculturation and current trend in cultural development.

230. PRIMITIVE RELIGION.
(3-0) Cr. 3. W.
Prerequisite: 218.

240. ARCHAEOLOGY OF NORTH AMERICA.
(3-0) Cr. 3. S.
Prerequisite: 3 credits in anthropology.
The prehistory and early history of North America as reconstructed from archaeological evidence; peopling of the New World, major culture historical developments north of the Rio Grande.

241. KINSHIP AND THE FAMILY IN DIFFERENT CULTURES.
(3-0) Cr. 3. S.
Prerequisite: 3 credits in anthropology.
Theories of kinship, marriage regulations, and divorce; significance of kinship systems in organization of social life; cross-cultural approach to study of the family.

242. CULTURE AND PERSONALITY.
(3-0) Cr. 3. W.
Prerequisite: 134, Psych. 101. 3 credits in anthropology.
Relationship of cultural, social, and personality factors in human behavior; analysis of generational transmission of culture.

243. ETHNOLOGY OF THE OLD WORLD.
(3-0) Cr. 3. W.
Prerequisite: 218.
An intensive ethnographic survey of cultures of the Old World. Contemporary peoples and their problems of transition.

244. INTERCULTURAL RELATIONS.
(3-0) Cr. 3. F.
Prerequisite: 9 credits in anthropology.
Analysis of culture contact and change with special emphasis on the impact of Western peoples and civilization on economically underdeveloped areas.

249. ARCHAEOLOGICAL FIELD SCHOOL AND LABORATORY METHODS.
Cr. 1 to 5. May be taken for Cr. 8 to 12 in Summer Field School. Summer and F. W. S.
Prerequisite: 3 credits in anthropology and consent of instructor.
Summer field school for training in archaeological reconnaissance and excavation techniques; documentation and interpretation of archaeological evidence. Laboratory processing and analysis of materials; preparation of preliminary archaeological report.

499. SPECIAL PROBLEMS.
Cr. 1 to 6 each time taken. F. W. S.
Prerequisite: 9 credits in Anthro.
A. Archaeology.
B. Cultural Anthropology.
C. Physical Anthropology.

COURSES PRIMARILY FOR GRADUATE STUDENTS, major or minor, open to qualified undergraduates

529. ADVANCED ARCHAEOLOGICAL METHODS.
Cr. 1 to 5. May be taken for Cr. 8 to 12 in Summer Field School.
Prerequisite: 429 and consent of Instructor.
Archaeological field techniques and laboratory methods. Reconstruction of sociocultural activities from archaeological evidence.

599. SPECIAL TOPICS.
Cr. 1 to 5. F. W. S.
Prerequisite: 15 credits in Anthro. 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

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


Assistant Professors: Barry C. Arnold, Ph.D.; Harold D. Baker, M.S.; Edward J. Carney, M.S.; Carol E. Fuchs, Ph.D.; David Jowett, Ph.D.; Edward Pollak, Ph.D.; David R. Thomas, Ph.D.; Richard Warren, Ph.D.

Instructors: Patricia S. Conn, M.S.; James S. DeGracle, M.S.; Richard W. Mensing, M.S.

Opportunities for 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 prepare students for (1) graduate study in statistics, and (2) positions as assistants to research workers in business, industry or government. This work may include the following: statistical design, analysis and interpretation of experiments and surveys; statistical quality control; sample inspection; high speed data processing; application of statistical principles and methods to industrial research and development and to industrial design and specifications; operations research to analyze the performance of men, machines and processes under operational conditions; market, sales, advertising and consumer research; cost and price analyses; newspaper, magazine, radio and television research; psychological testing; public health studies. Also, there are opportunities for work in statistics that require a major in a subject-matter field and a minor in statistics.

Undergraduate majors in this department usually include the following basic courses in their programs: 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 mathematics numbered 300 or higher. It is also advisable to have a strong minor in a field of application. These lists of courses are not to be regarded as statements of fixed requirements or as complete outlines of the work necessary for the major. They are given solely for the convenience of students or advisers who wish to estimate the amount of basic, non-specialized study which may be needed.

Students intending to do graduate work in statistics normally would take additional courses in mathematics.

Opportunities for 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 science 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.

Open to graduate students for minor only: 401, 402, 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 Math.  
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 Math. 
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. ELEMENTARY BUSINESS STATISTICS.  
(2-3) Cr. 3. F. 
Prerequisite: 201. 
Applications of statistical principles to business; sources of data; elementary discussion of index numbers, time series, forecasting, and quality control.  

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; role of the theory of stochastic processes; simple time dependent processes; Markov chains; 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.  
(C.S. 380) (2-3) Cr. 3. F.W.S. 
Prerequisite: 201, C.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.SSI.
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.

411. EXPERIMENTAL DESIGN FOR RESEARCH WORKERS.
(3-0) Cr. 3. S.SSI.
Prerequisite: 402. Cady, Hotchkiss, Jowett. Methods of constructing and analyzing designs for experimental investigations; concepts of blocking, randomization and replication; experimental unit technique; complete block designs; confounding in factorial experiments; incomplete block designs, response surface methodology.

421. SURVEY DESIGNS FOR RESEARCH WORKERS.
(3-0) Cr. 3. S.SSI.
Prerequisite: 401. Methods of constructing and analyzing designs for survey investigations; simple random, stratified, multistage and multiphase sampling designs; questionnaire construction; methods of estimation, techniques of survey investigations.

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.

438. ECONOMIC STATISTICS.
(Econ. 438) (3-0) Cr. 3. S.
Prerequisite: 402. Analysis of economic data obtained through research investigations. Applications of regression techniques to production functions, demand functions, cost functions, etc. Brief treatment of index numbers.

446, 447, 448. STATISTICAL THEORY FOR RESEARCH WORKERS.
(3-0) Cr. 3 each. 446: F.; 447: W.S.SSI.; 448: S.SSI.
Prerequisite: 446: one year of college mathematics; 447: 446 or Math. 112; 448: 447. Primarily for graduate students not majoring in statistics. Emphasis on the aspects of probability theory underlying statistical methods, probability, population distribution functions and their properties, sampling distributions, orthogonal linear functions, estimation, tests of hypotheses, regression.

481. PROCESSING OF STATISTICAL DATA.
(C.S. 481) (2-0) Cr. 2. W.
Prerequisite: 401, C.S. 214. Introduction to programming statistical analyses for research problems. Not open for credit to students who have had 380.

482. PROCESSING OF STATISTICAL DATA.
(C.S. 482) Cr. 2. S.
Prerequisite: 402, 380 or 481. Use of high-speed electronic computers in problems in statistical analysis. Programming techniques include assembly and compiler routines.

499. SPECIAL PROBLEMS.
Cr. arr.
Prerequisite: 15 hours in Stat. For advanced undergraduate and graduate minor students. II Honors Program

COURSES PRIMARILY FOR GRADUATE STUDENTS, major or minor, open to qualified undergraduates

501. INTERMEDIATE STATISTICAL METHODS.
(3-0) Cr. 3. F.
Prerequisite: 402. Bancroft. Special situations in the analysis of variance; multiple comparisons; transformations; multiple covariance; fitting of polynomials and non-linear regression, extension of chi-square applications.

505. PSYCHOMETRICS.
(Psych. 505) (3-0) Cr. 3. S.
Prerequisite: 402. Psych. 440. Wolins. Theories of psychometric 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 1967.

511. 512. DESIGN OF EXPERIMENTS.
(3-0) Cr. 3 each. W.S.
Prerequisite: 402. Zyskind. Principles of statistical design for experimental investigations in biological, agricultural and industrial research; tests; estimation; randomized blocks; Latin-squares; Graeco-Latin squares; 2n, 3n and other factorial systems; fractional replication; simple split-plot trials; introduction to quasi-factorial and incomplete block designs; determination of optima.
COURSES FOR GRADUATE STUDENTS, major or minor

540. OPERATIONS RESEARCH METHODS AND ECONOMIC ANALYSIS.
(Econ. 540, I.E. 540) (3-0) Cr. 3 S.
Prerequisite: 446 or Math. 112, Econ. 537 or I.E. 415 or Stat. 539. Sengupta.
Techniques of inventory control and management; other types of control, forecasting and optimization techniques; methods of simulation and sensitivity programming and their economic applications; programming under risk in dynamic models of transportation, allocation and replacement; dynamic and recursive programming; methods of quantitative planning of economic policy.

541. 542, 543. THEORY OF PROBABILITY AND STATISTICS.
(1.0. 541, 542, 543) (3-0) Cr. 3 each Yr.
Prerequisite: 541: Math. 414; 542: 541; Math. 415; 543: 542. Arnold.
Development of distribution theory from the theory of probability; common distribution functions; derivation of sampling distributions with particular attention to normal populations; estimation by maximum likelihood; likelihood ratio tests of parametric hypotheses; introduction to general linear hypothesis; the theory of sequential analysis; distribution free methods.

544. STATISTICAL DECISION THEORY.
(3-0) Cr. 3. Alt. S. Offered 1968.
Prerequisite: 539. David.
Admissibility and completeness; decision functions; Bayes and minimax solutions; sequential and nonsequential cases; utility and principles of choice.

545. STOCHASTIC PROCESSES.
(Math. 545) (3-0) Cr. 3. SIII.
Prerequisite: 541 or Math. 555. Arnold.
Stationary processes with emphasis on the time domain; transients and deterministic processes; normal and Poisson processes; renewal theory; Markov chains; harmonic analysis of processes.

546, 555. PROBABILITY.
(Math. 554, 555) See Mathematics.

580. COMPUTATIONAL TECHNIQUES IN STATISTICS: METHODS.
(C.S. 580) (3-0) Cr. 3 W.
Prerequisite: 402, 380, Math. 404.
Programming techniques and methods for solution of problems in multiple linear regression, non-linear regression, analysis of variance.

581. COMPUTATIONAL TECHNIQUES IN STATISTICS: THEORY.
(C.S. 581) (3-0) Cr. 3 S.
Prerequisite: 343 or 448 or 543, 380, Math. 414.
Topics in the use of digital computers for theoretical investigations in statistics. Evaluating statistical distribution functions, Monte Carlo techniques, programming symbolic operations.

599. SPECIAL TOPICS.
Cr. arr. Graduate staff.
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. Cox.
Principles of regression analysis; general orthogonal polynomials; multivariate analysis including Hotelling's T^2, the linear discriminant function and the analysis of dispersion; regression non-linear in the parameters; seminars on special topics.

532. INDUSTRIAL STATISTICS: DESIGN OF EXPERIMENTS.
(I.E. 532) (3-0) Cr. 3 Alt. S. Offered 1969.
Prerequisite: 402, 531. David.
Principles and methods of designing industrial experiments. Methods of analysis Half-normal plots; minimum cost allocations in regression.

535. BIOLOGICAL STATISTICS.
(3-0) Cr. 3 S.
Prerequisite: 402. 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.
(1.0. 536, 537) (3-0) Cr. 3 each F.W.
Prerequisite: 402, 448, Gen. 301; or Gen. 460, permission of instructor. Pollak.
Probability as applied to genetic systems; the theory of inbreeding; estimation of genetic parameters and testing of genetic hypotheses; models for quantitative inheritance; the partition 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.
(Econ. 538) (3-0) Cr. 3 F.
Prerequisite: 448. Fuller.
Generalized linear regression models, dummy variables; miscellaneous estimation problems, autocorrelated errors, errors in variables, multicollinearity, estimation of parameters in simultaneous equation systems.

539. OPERATIONS RESEARCH.
(Econ. 539, I.E. 539, Math. 539) (3-0) Cr. 3 W.
Prerequisite: 543 or 448.
Topics in game theory, programming, and the theory of queues.

540. OPERATIONS RESEARCH METHODS AND ECONOMIC ANALYSIS.
(Econ. 540, I.E. 540) (3-0) Cr. 3 S.
Prerequisite: 446 or Math. 112, Econ. 537 or I.E. 415 or Stat. 539. Sengupta.
Techniques of inventory control and management; other types of control, forecasting and optimization techniques; methods of simulation and sensitivity programming and their economic applications; programming under risk in dynamic models of transportation, allocation and replacement; dynamic and recursive programming; methods of quantitative planning of economic policy.

541. 542, 543. THEORY OF PROBABILITY AND STATISTICS.
(1.0. 541, 542, 543) (3-0) Cr. 3 each Yr.
Prerequisite: 541: Math. 414; 542: 541; Math. 415; 543: 542. Arnold.
Development of distribution theory from the theory of probability; common distribution functions; derivation of sampling distributions with particular attention to normal populations; estimation by maximum likelihood; likelihood ratio tests of parametric hypotheses; introduction to general linear hypothesis; the theory of sequential analysis; distribution free methods.

544. STATISTICAL DECISION THEORY.
(3-0) Cr. 3. Alt. S. Offered 1968.
Prerequisite: 539. David.
Admissibility and completeness; decision functions; Bayes and minimax solutions; sequential and nonsequential cases; utility and principles of choice.

545. STOCHASTIC PROCESSES.
(Math. 545) (3-0) Cr. 3. SIII.
Prerequisite: 541 or Math. 555. Arnold.
Stationary processes with emphasis on the time domain; transients and deterministic processes; normal and Poisson processes; renewal theory; Markov chains; harmonic analysis of processes.

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(Math. 554, 555) See Mathematics.

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(C.S. 580) (3-0) Cr. 3 W.
Prerequisite: 402, 380, Math. 404.
Programming techniques and methods for solution of problems in multiple linear regression, non-linear regression, analysis of variance.

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Prerequisite: 343 or 448 or 543, 380, Math. 414.
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599. SPECIAL TOPICS.
Cr. arr. Graduate staff.
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. Cox.
Principles of regression analysis; general orthogonal polynomials; multivariate analysis including Hotelling's T^2, the linear discriminant function and the analysis of dispersion; regression 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 1969.
Prerequisite: 512, 641. Kemthorne.
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 1968.
Prerequisite: 522, 543. Aggarwal.
Advanced topics in sampling theory as used in survey design; unequal probability sampling with and without replacement; unbiased ratio and regression type estimators; analytical treatment of non-sampling errors.

622. SEMINAR ON DESIGN OF SURVEYS.
Cr. arr. Alt. S. Offered 1968.
Prerequisite: 621. Aggarwal.
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 1968.
Prerequisite: 538, 543.
Simultaneous equation systems of economic relationships; identification, methods of estimating structural parameters, and computational layout. Simultaneous equation models with autocorrelated disturbances. Distributed lag models. Problems of specification, aggregation, and prediction in econometric analysis.

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. F.
Prerequisite: 543. Kale.
Probability measure and distribution functions; random variables; characteristic functions; asymptotic distributions.

643. THEORY OF ESTIMATION AND TESTING OF HYPOTHESES.
(3-0) Cr. 3. W.
Prerequisite: 543. Kale.
Neyman-Pearson theory of testing hypotheses; point and interval estimation; sufficient statistics; elements of decision theory.

646. TIME SERIES.
(Econ. 646) (3-0) Cr. 3. S.
Prerequisite: 448 or 543. Fuller.
Stochastic processes; covariance and spectral representations; moving average and autoregressive 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. S.
Prerequisite: 543, Math. 404. Kudo.
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 one of the following or other modern areas which become sufficiently important. Sequential analysis, decision theory, nonparametric inference, stochastic processes.

680. SEMINAR ON STATISTICAL COMPUTATIONS.
(C.S. 680) 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. Graduate staff.

TEACHER EDUCATION

Virgil S. Lagomarcino, Ph.D., Director

University Committee on Teacher Education: Virgil S. Lagomarcino, Ph.D., Chairman: Ray J. Bryan, Ph.D., Head, Department of Education; D. Bruce Gardner, Ph.D., Head, Department of Child Development; William R. Underhill, Ph.D., Chairman, Secondary Teacher Preparation, College of Sciences and Humanities; Wilbur L. Layton, Ph.D., Head, Department of Psychology; Alberta D. Hill, Ed.D., Head, Department of Home Economics Education; Harold E. Dilts, Ph.D., Committee Secretary.
Teacher Certification

The Iowa Professional Certificate will be recommended for a person who holds a bachelor's degree from Iowa State University and who has completed the following:

1. All requirements of an approved teacher education program.
2. A minimum of 75 credits in courses designed to serve the general needs of college students. Govt. 215 is to be included.
3. An approved subject matter concentration area of at least 45 credits for full-time teaching in secondary schools. A second subject matter area of at least 30 credits for half-time teaching is desirable but not required.
4. Approval for the elementary certificate requires the successful completion of the curriculum in Child Development-Elementary Education.

The permanent professional certificate may be recommended for a person who has met the requirements for the professional certificate, who has earned a Master's Degree and who has four years of successful teaching experience.

Graduate programs are available for those who seek approval as secondary school principals, superintendents, school psychologists, teacher-counselors, counselors, and as teachers in junior colleges.

Persons interested in types of certificates not described above, or who wish to know what courses meet the specific requirements of any certificate, should communicate with the Director of Teacher Education.

Undergraduate Programs in Teacher Education

Personnel and Facilities

Teacher preparation at Iowa State University is a cooperative endeavor involving the personnel and facilities of the University. However, most of the teacher education activities are in the Colleges of Agriculture, Home Economics, and Sciences and Humanities.

Undergraduate Admission

Students seeking admission to a teacher education program must apply to and be accepted by the committee on selection of the specific program in Agricultural Education, Art, Child Development-Elementary Education, Home Economics Education, Industrial Education, Physical Education for Women, or Sciences and Humanities. Each committee will consider the factors of scholarship (minimum of 2.3 quality point average), interest in teaching, character, and physical and mental health. Students should apply as early as possible but not later than the fourth quarter preceding the one in which they intend to do student teaching. All students recommended by the selection committees must be confirmed by the University Committee on Teacher Education before they can be admitted to the program in teacher education.

Undergraduate Areas of Concentration and Advisers

Details of each area will be found in the appropriate departmental section.

Elementary Education:
D. Bruce Gardner

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
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 Education, Lillian C. Schwenk
Social Studies (Economics, Sociology, Government, Geography and History),
Phillip B. Zarring
Speech, William R. Underhill

* Students qualifying to teach Safety Education also must qualify in another teaching area.

General Education

A total of 75 credits is required in General Education and shall be distributed as follows:

<table>
<thead>
<tr>
<th>Category</th>
<th>Credits</th>
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<tbody>
<tr>
<td>Biological Sciences</td>
<td>9-21</td>
</tr>
<tr>
<td>Communicative Arts</td>
<td>15-21</td>
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<tr>
<td>Humanities</td>
<td></td>
</tr>
<tr>
<td>Physical Sciences and Mathematics</td>
<td>9-21</td>
</tr>
<tr>
<td>Social Sciences</td>
<td>9-21</td>
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</tbody>
</table>

Core Courses in Teacher Education

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
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<tbody>
<tr>
<td>Developmental Psychology - Psych 230</td>
<td>3</td>
</tr>
<tr>
<td>Educational Psychology - Psych 333</td>
<td>3</td>
</tr>
<tr>
<td>Foundations of American Education - Ed 204</td>
<td>3</td>
</tr>
<tr>
<td>Methods of Teaching - Ed 3058</td>
<td>1</td>
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</tbody>
</table>

Elementary Education

See Major in Child Development - Elementary Education for courses required.

Secondary Education

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
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<tbody>
<tr>
<td>Methods of Teaching - Ed 305A</td>
<td>3</td>
</tr>
<tr>
<td>Principles of Secondary Education - Ed 426</td>
<td>3</td>
</tr>
<tr>
<td>Professional Courses in Areas of Concentration</td>
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<tr>
<td>Agricultural Education: 211, 321, 423, 424, 425.</td>
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<tr>
<td>Art: 416, 417.</td>
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<td>Biology: Sci. 417D, 486.</td>
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<td>Earth Science: Sci. 417J, 486.</td>
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<td>English: Sci. 417E, 494.</td>
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<td>Foreign Languages: 476, Sci. 417G.</td>
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<tr>
<td>General Science: Sci. 417B, 486.</td>
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<tr>
<td>Industrial Education: 415, 416.</td>
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<tr>
<td>Mathematics: 497, Sci. 417C.</td>
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<tr>
<td>Music: 363, 365 or 366, 390A, Sci. 417K.</td>
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<tr>
<td>Physical Education for Men: 497, Sci. 417F.</td>
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<tr>
<td>Physical Education for Women: 417.</td>
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<tr>
<td>Physics: Sci. 417B, 486.</td>
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<tr>
<td>Safety Education: Psych. 274, 370, 372.</td>
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<tr>
<td>Social Studies: Sci. 417A, 496.</td>
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<tr>
<td>Speech: 495, Sci. 417H.</td>
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</tbody>
</table>
Graduate Programs in Teacher Education

Graduate programs are planned for each student on the basis of previous education and experience as well as future plans and needs. As a prerequisite to major graduate work in education a student should have preparation substantially equivalent to the completion of one of the undergraduate curricula in teacher education offered at Iowa State University.

Graduate programs are available in the following areas:

a. Agricultural Education
b. Applied Art
c. Child Development
d. Guidance (Teacher-Counselor, Counselor)
e. Home Economics Education
f. School Administration
h. School Psychology
i. Graduate programs for teachers in many of the departments in the Colleges of Home Economics and Sciences and Humanities.
j. Master of Science Degree with a major in General Science, for students who desire more diversified study than generally is permitted when specializing in a single subject matter area.

For further information on each area, see Index.

Course offerings on the graduate level are described in the departmental listings, which are arranged alphabetically under Description of Courses.

Teacher Placement

A Teacher Placement Office is maintained for students and graduates in teacher education who are interested in positions in education. Placement services are extended both to candidates and to employers. The candidate is charged a small registration fee. Requests for placement information should be addressed to the Teacher Placement Office, 3 Beardshear, Iowa State University, Ames, Iowa. 50010.
TECHNICAL JOURNALISM

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.; K. Robert Kern, Ph.D.; William F. Kunerth, M.S.J.; John D. Shelley, B.J.; Donald E. Wells, Ph.D.

Assistant Professors: Merritt Bailey, M.S.; C. Gene Bratton, M.S.; Robert L. Crom, M.S.; Raymond P. Fassel, M.A.; Robert C. Johnson, M.S.; LaRue Pollard, M.S.; James T. Emmerson, M.S.

Instructor: James A. Crook, M.A.

Opportunities for Undergraduate Study

For undergraduate curricula in agricultural communication, home economics journalism, science journalism, and engineering journalism, see Index.

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.

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.

Opportunities for 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.

Options for the foreign language requirement include Spanish, French, German, and Russian.

Open to graduate students for minor only: 417, 430, 431, 462, 463, 464.

COURSES PRIMARILY FOR UNDERGRADUATE STUDENTS

101. INTRODUCTION TO MASS COMMUNICATION.
   (2-0) Cr. 2. F.W.S.
   Communication models and their application to the mass media; the mass communication process; characteristics and responsibilities of the mass media; media-related professional operations.

221, 222, 223. BASIC REPORTING.
   221, 222; (2-6) Cr. 4. F.W.S.; 223: (2-0) Cr. 3. 1 hr. arr. F.W.S.
   Prerequisite: 221: 101, Engl. 102, some proficiency in typing; 222: 221 or equivalent; 223: 222 or 225.
   News values, news style, news gathering and writing. Sequence will move through newspaper news writing into specialized coverage of courts, public affairs and business news with emphasis finally shifting to the writing of articles for general and specialized magazines in which considerable attention is given to reporting of scientific and technical information.

225. PUBLICITY AND PUBLIC RELATIONS.
   (3-0) Cr. 3. F.W.S. SSI.SSII.
   Prerequisite: Engl. 103.
   Communication fundamentals; gathering and preparing material for mass communication media; use of communication media for public relations purposes.

252. RADIO NEWS REPORTING.
   (3-3) Cr. 4. W.
   Prerequisite: 221 or equivalent.
   Basic writing and news-gathering techniques for the broadcast media. Emphasis on radio. Field trips.
317. FUNDAMENTALS OF PHOTOGRAPHY.
(2-6) Cr. 4. F.W.S.SSI.
Camera and dark room techniques. Evaluation of pictures; the picture story; lighting; pictorial composition.

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. F.
Prerequisite: 325.
Analysis of broadcast media; preparation of radio and television commercials; time buying.

337. PRINT MEDIA ADVERTISING.
(3-0) Cr. 3. 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. S.
Prerequisite: 325.
Development of national and local advertising and public relations campaigns; strategy and planning; media and market selection; audience identification and description; testing effects.

341, 342. COPY EDITING AND TYPOGRAPHY.
(2-3) Cr. 3 each. 341: F.S.; 342: W.S.SSI.
Prerequisite: 221 or 225.
Copy editing; headline writing and newspaper makeup. Type, copy fitting and design of printed matter.

352. TELEVISION NEWS REPORTING.
(2-3) Cr. 3. F.
Prerequisite: 252.
Writing, editing, preparation of broadcast news and public affairs programs. Emphasis on television; use of newsfilm. Field trips.

400. SPECIALIZED WRITING.
(3-0) Cr. 3 each time elected.
400A: F. 400B: S. 400C: W.
Prerequisite: 222, junior classification.
Personal guidance in researching material and writing for areas related to the student's special interests and background.
A. Magazine and Industrial Publications.
B. Reporting Public Affairs.
C. The Editorial Page.

417. PICTORIAL COMMUNICATION.
(3-0 to 3-6) Cr. 3 or 5. W.
Prerequisite: 221 or 225 or graduate standing; 317 for laboratory.
A survey of the uses in communication of photographs, drawings, graphs, charts, maps and non-word symbols. Special emphasis on how to communicate by means of pictures. Laboratory emphasis on photographic composition and print quality.

430. LAW OF COMMUNICATIONS.
(3-0) Cr. 3. F.S.
Prerequisite: Junior classification.
Libel, slander, lottery, copyright; postal laws; the Federal Communications Act; laws affecting advertising and legal publication.

431. HISTORY OF JOURNALISM.
(3-0) Cr. 3. W.
Prerequisite: Junior classification.

462. PRESS FREEDOM, RESPONSIBILITY AND ETHICS.
(3-0) Cr. 3. F.S.SSI.
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.

475. INFORMATIVE WRITING FOR RADIO AND TELEVISION.
(3-3) Cr. 3. F.S.SSI.
Prerequisite: 221 or 225.
Writing and planning continuity, talks, interviews, demonstrations, forums and discussions; documentary programs for radio and television. Field trips.

476. MOTION PICTURE TECHNIQUES.
(2-3) Cr. 3. F.
Prerequisite: 317.
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.

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)
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. LITERATURE IN MASS COMMUNICATION.
(3-0) Cr. 3. W.
Prerequisite: 510.
Examination of major areas of research activity and theoretical development related to the organization, functions and effects of mass communication.

515. PERSUASION AND MASS COMMUNICATION.
(3-0) Cr. 3. S.SSI.
Prerequisite: 221 or 225 or graduate standing.
Survey and synthesis of some of the major factors influencing public opinion and a study of their importance in editorial writing, advertising and public relations.

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.
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.

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.

COURSES FOR GRADUATE STUDENTS

650. SEMINARS IN JOURNALISM/COMMUNICATION.
Cr. 3 each.
B. History. Alt. W. Offered 1968

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 Potgietter, M.A., (Emeritus); Jane Saddler, M.S.; Geitel Winakor, Ph.D.
Associate Professor: Ruth E. Hall, Ph.D.; Harriett T. McJimsey, M.A.; Opal M. Roberson, M.A.
Instructors: Brenda B. Focht, M.S.; Martha McKibben, B.S.; Mary E. Nieman, M.S.

Opportunities for Undergraduate Study
Courses in textiles and clothing furnish knowledge and training essential to the consumer for satisfactorily 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.

Five majors are offered: merchandising, textiles and clothing design, textiles, clothing, and textiles and related science. Each of these majors provides preparation for many different kinds of positions and provides a basis for advanced study.
The major in merchandising prepares students 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, promotion work, 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 design is planned for students interested in apparel designing.

The major in textiles prepares students for work in quality control laboratories as consultants for promotional fabric development.

The major in clothing leads to opportunities in many areas such as teaching in stores, extension or trade schools, custom dressmaking, work with commercial companies as consultant, sample maker, or educational director.

The major in textiles and related science is designed for those who wish to prepare for work in textile laboratories or for graduate study in textiles and clothing.

Opportunities for Graduate Study

The department offers major work for the degree Master of Science and minor work to students taking major work in other departments.

Prerequisite to major graduate work is the completion of courses in applied art, chemistry (including inorganic and organic), economics, 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.

For the language requirements see Graduate College.

Open to graduate students, for minor only: 404, 410, 414, 454, 464.

COURSES PRIMARILY FOR UNDERGRADUATE STUDENTS

104. TEXTILES. (2-3) Cr. 3. F.W.S.SSI.
Fundamental weaves, yarn, fibers, color and finishes with reference to selection of fabrics in relation to end use.

123. PATTERN MAKING AND CLOTHING CONSTRUCTION. (2-10) Cr. arr. 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 or Y. 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.

223. PATTERN MAKING. (2-7) Cr. 4. W.
Prerequisite: Transfer students in H.Ec.Ed. who have had a course in clothing construction.
Flat pattern designing and draping with emphasis on fitting.

225. DRAPING AND CLOTHING CONSTRUCTION. (2-4) Cr. 3. F.W.S.SS.
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.
365. PROFESSIONAL OPPORTUNITIES IN TEXTILES AND CLOTHING.
(3-0) Cr. 3 W.
Prerequisite: Junior or senior classification.
Survey of career opportunities related to various job areas of merchandising, designing, promotion, public relations, consumer service, research and textile testing. Individual investigations of specific jobs.

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.S.S.
Prerequisite: 104, Hist. 205, 206.
Development of textiles from ancient times; a study of specific historic textiles; contemporary interpretations of historic textile designs.

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.

525. ADVANCED DRAPING.
(2-4) Cr. 3 S.SS.
Prerequisite: 225, 345. Saddler.
Application of design and pattern making principles to various fabrics and styles.

527. TAILORING.
(2-6) Cr. 4 F.W.S.S.S.
Prerequisite: 225.
Tailoring techniques applied in making coats and suits.

544. ADVANCED COSTUME DESIGN.
(2-4) Cr. 3 W.

545. HISTORY OF COSTUME.
(3-0) Cr. 3 F.W.S.S.S.
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.

564. THE SOCIAL AND PSYCHOLOGICAL ASPECTS OF CLOTHING AND TEXTILES.
(3-0) Cr. 3 W.S.
Prerequisite: 104, 245, Soc. 134, Psych. 101. Hall.
The production and consumption of clothing and textiles as they are related to the theories learned in the social sciences. Clothing behavior of individuals and of groups in the United States and in other societies will be studied.

590. SPECIAL TOPICS.
F.W.S.S.S.
Prerequisite: Permission of the department head and professor or professors concerned.
A. Textiles. Hollen, Lewis, Saddler.
B. Historic Textiles. Huepenbecker.
C. Clothing Construction. Staff.
D. Costume Design. McJimsey.
E. History of Costume. Winakor.
F. Socio-Psychological Aspects of Textiles and Clothing. Warning.

610. SEMINAR.
Cr. arr. W. Winakor.

614. RESEARCH.
F.W.S.S.S.S.
Hall, Hollen, McJimsey, Warning, Winakor.
COURSES FOR GRADUATE STUDENTS

650. SEMINAR.
R. (3-0) Cr. 3.

690. RESEARCH.

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.


Assistant Professor: John F. Munnell, V.M.D.


Opportunities for 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.

Opportunities for 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 in ultrastructure of cells and tissues.

Courses 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. F.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 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. 5. W.
Prerequisite: 302, 312, permission or 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.

490. SPECIAL PROBLEMS.
Cr. 1 to 5 each time taken. Yr.
Prerequisite: Permission of department head. Staff.

COURSES PRIMARILY FOR GRADUATE STUDENTS, major or minor, open to qualified undergraduates

510. ENDOCRINOLOGY.
(V.Phys. 510) (4-3) Cr. 5. Alt. S. Offered 1967.
Prerequisite: Permission of instructor.
Getty, Gillette, Swenson, Lovell, Haensly.
Embryology, structure and function of endocrine organs.

511. NEUROANATOMY.
(Vet. Path. 511) (2-0 or 2-6) Cr. 2 or 4. Alt. W. Offered 1967.
Prerequisite: Permission of instructor. Getty, 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 and Chem. 483. Cholvin, Getty.

590. SPECIAL TOPICS.
Cr. 2 to 6 each time elected.
Prerequisite: 15 credits of acceptable graduate work, permission of instructor. Staff.
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. Staff.
B. Microscopic Anatomy. Staff.
VETERINARY CLINICAL SCIENCES

Wallace M. Wass, D.V.M., Ph.D., Head of Department


Opportunities for Undergraduate Study

For undergraduate curriculum in veterinary medicine leading to the degree Doctor of Veterinary Medicine, see Veterinary Medicine, Curriculum.

The study of medicine and surgery summarizes and 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.

Opportunities for Graduate Study

The department offers major work leading to the degree Master of Science in the Veterinary Clinical Sciences. 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.
COURSES FOR GRADUATE STUDENTS, major or minor, open to qualified undergraduates

590. SPECIAL TOPICS.
Cr. 1 to 5. F.W.S.
Prerequisite: Permission of instructor.

COURSES FOR GRADUATE STUDENTS, major or minor

604. SEMINAR.
Cr. 1. F.W.S.

610. 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. W. alternate years. Offered 1968.
Prerequisite: 391 and 447. Lovell. Diseases of reproductive organs of the male with special emphasis on diagnostic procedures.

645. ADVANCED OBSTETRICS.
(2-3 or 9) Cr. 3 or 5. W. alternate years. Offered 1968.
Prerequisite: 391 and 447. Lovell. 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: 448. Wass. 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. W. alternate years.
Prerequisite: 448. 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. S. alternate years.
Prerequisite: 448 or equivalent. Wass, Buck. An advanced study of metabolic diseases.
Description of Courses

678. LABORATORY ANIMAL MEDICINE.
(3-0) Cr. 3. SSI, SSII. alternate years.
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


Associate Professors: Merlin L. Kaeberle, D.V.M., Ph.D.; Ralph W. Mohri, D.V.M.

Assistant Professors: Merwin L. Frey, D.V.M., Ph.D.; Roger M. Hogle, D.V.M.; Richard F. Ross, D.V.M., Ph.D.; Martin Van Der Maaten, D.V.M., Ph.D.

Instructor: Billy J. Edmundson, D.V.M.

Opportunities for 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.

Opportunities for Graduate Study

The department offers major work for the degree Master of Science in veterinary microbiology and veterinary preventive medicine, major work for the degree Doctor of Philosophy in veterinary bacteriology 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. F.
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. W.
Prerequisite: 381, V. Path. 371.
Detailed study of bacteria associated with animal diseases.

383. VIROLOGY AND PRINCIPLES OF EPIDEMIOLOGY.
(4-4) Cr. 5. S.
Prerequisite: 381, V. Path. 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.

434. PUBLIC HEALTH I.
(3-0) Cr. 3. F.
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. W.
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. S.
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 1968.
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.
(2-6) Cr. 4. F.
Prerequisite: 381 or Bact. 304. Kaeberle. Principles of serological diagnosis of the infectious diseases of animals.

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.
(3-0) or (3-4) Cr. 3 or 5. S.
Prerequisite: 509, permission of instructor. Advanced study of animal virus host-cell reactions 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. Mechanisms of resistance to disease including natural and acquired immunity. Nature of immune substances, their production and role in health and disease.

690. RESEARCH.
Frank, Hofstad, Kaeberle, Manthei, Merchant, Packer, Switzer, Wedman.

VETERINARY PATHOLOGY
Frank K. Ramsey, D.V.M., Ph.D., Head of Department


Assistant Professors: Arlo E. Ledet, D.V.M., M.S.; Virginia L. Marshall, M.S.; Chennekatu P. Peter, B.V.Sc., M.S.

Instructor: Kay S. Pierce, B.S.

Opportunities for Undergraduate Study

For undergraduate curriculum in veterinary medicine leading to the degree Doctor of Veterinary Medicine, see Veterinary Medicine, Curriculum.
Description of Courses

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.

Opportunities for 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.

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, chemistry, zoology, entomology, physics, botany, genetics, psychology, or education.

COURSES PRIMARILY FOR UNDERGRADUATE STUDENTS

371. GENERAL PATHOLOGY.
   (3-4) Cr. 5. F.  
   Prerequisite: V. Anat. 303, 313, V. Phys. 316.  
   Response of body tissues to disease.

376, 377. VETERINARY PARASITOLOGY.
   376: (3-3); 377: (4-3) Cr. 4 and 5. W.S.  
   Prerequisite: 376: 371; 377: 376.  
   Parasites and parasitic diseases of animals and the principles of their control.

421, 422, 423. SPECIAL PATHOLOGY.
   421: (4-4); 422: (4-4); 423: (2-2) Cr. 6, 6 and 3. F.W.S.  
   Prerequisite: 421: 371; 422: 421; 423: 422.  
   Pathogenesis of the major diseases affecting the animal body.

456. VETERINARY TOXICOLOGY AND POISONOUS PLANTS.
   (2-9) Cr. 5. S.  
   Prerequisite: 422.  
   A study of the diagnosis of diseases caused by and the mode of action of toxicologic compounds.

490. 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

511. NEUROANATOMY.
   (V. Anat. 511) (2-0 or 2-6) Cr. 2 or 4.  
   Alt. F. Offered 1968.  
   Prerequisite: Permission of instructor. Get­ty, Ramsey.  
   Central and peripheral nervous systems including the organs of special sense

551. GENERAL PATHOLOGY.
   (3-4) Cr. 5. F.  
   Prerequisite: V. Anat. 303, 313. Ramsey, Duncan.  
   Fundamentals of disease with emphasis on disease in animals.

552, 553. SPECIAL PATHOLOGY.
   552: (3-4); 553: (3-6) Cr. 5 each. W.S.  
   Prerequisite: 552: 551; 553: 552. Ramsey, Duncan.  
   General pathologic fundamentals applying to organs or systems of organs.

554. VETERINARY TOXICOLOGY.
   (3-0 or 3-4) Cr. 3 or 5. Alt. W. Offered 1967-68.  
   Prerequisite: 371 or equivalent. Buck.  
   Disease processes in animals caused by toxicants, differential diagnostic procedures, and identification of toxicants by laboratory tests.

557, 558. VETERINARY PARASITOLOGY.
   557: (3-2); 558: (3-3) Cr. 4 each. W.S.  
   Prerequisite: 557: Permission of instructor; 558: 557. Benbrook, Greve.  
   Problems of parasitism in relation to animals.

590. SPECIAL TOPICS.
   Cr. 1 to 5. F.W.S.  
   Prerequisite: 423. Ramsey.  
   Special topics in the field of veterinary pathology and parasitology

COURSES FOR GRADUATE STUDENTS, major or minor

604. SEMINAR.
   Cr. 1. F.W.S. Buck, Duncan, Greve, Ram­sey, Zimmermann.

653. CELLULAR PATHOLOGY.
   (3-0 or 3-4) Cr. 3 or 5. F.  
   Prerequisite: 423 or equivalent. Ramsey, Duncan.  
   Fundamentals involved in the pathogenesis of disease processes.

654. VETERINARY NEUROPATHOLOGY.
   (3-6) Cr. 5. Alt. S. Offered 1969.  
   Prerequisite: 511, 553. Ramsey.  
   Advanced study of diseases of the nervous system.
655. PHYSIOPATHOLOGY OF THE SKELETAL SYSTEM.
(3-0 or 3-4) Cr. 3 or 5. Alt. W. Offered 1968-69.
Prerequisite: 653. Ramsey.
An advanced study of the nutritional and infectious diseases of bones and joints of animals.

656. ADVANCED VETERINARY PATHOLOGY.
(1-3 to 12) Cr. 2 to 5. F.W.S.
Prerequisite: 377, 423 or 553, 558.
A Experimental Pathology Greve, Ramsey, Zimmermann, Duncan.
B. Experimental Parasitology Greve, Zimmermann.
C Advanced Post-Mortem Techniques Ramsey, Duncan.
D Pathologic Hematology Sloss.
E Mycotic and Parasitic Granulomatous Diseases Ramsey.
F Neoplasms of Domestic Animals Ramsey.

657. ADVANCED VETERINARY TOXICOLOGY.
(1-3 to 1-12) Cr. 2 to 5. Alt. W. Offered 1968-69.
Prerequisite: 554, 653. Buck, Duncan.
Advanced study of specific toxicants as related to animal diseases, public health hazards and the chronic effects of agricultural chemicals on animal tissues.

659. ADVANCED VETERINARY PARASITOLOGY.
(1-3 to 1-12) Cr. 2 to 5. F.W.S.
Prerequisite: 377, 423 or 558. Benbrook, Greve, Zimmermann.
Introduction to research in animal parasitology.

660. PATHOLOGY OF PARASITIC DISEASES.
(2-6) Cr. 5. Alt. SS. Offered 1968.
Prerequisite: 551 or equivalent. Greve, Zimmermann.

690. RESEARCH.
A Veterinary Pathology Benbrook, Ramsey, Schwarte, Duncan, Buck.
B Veterinary Parasitology Benbrook, Greve, Zimmermann.

VETERINARY PHYSIOLOGY AND PHARMACOLOGY

Melvin J. Swenson, D.V.M., Ph.D., Head of Department


Opportunities for 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.

Opportunities for 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.

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 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. Anat. 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. Anat. 304 and B & B 304 or V. Anat. 301 and 311.
Physiology of body fluids, water, electrolytes, blood, and excretion. Courses 314, 315, and 316 are designed for veterinary students and non-IVM 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.

COURSES PRIMARILY FOR GRADUATE STUDENTS, major or minor, open to qualified undergraduates

Prerequisite: Permission of instructor.Getty, Swenson.
Embryology, structure, and function of endocrine organs.

512. NEUROPHYSIOLOGY. (3-3) Cr. 4. W.
Prerequisite: V. Anat. 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 1-0*) Cr. 4 or 1*.
Prerequisite: V. Anat. 513. Cholvin, Engen, Kolde.
Mammalian physiology from an engineering point of view. Quantitative and comparative study of circulation, diffusion, autonomic, and neuromuscular systems. Emphasis on biological control mechanisms.

515. PHYSIOLOGY FOR BIOMEDICAL ENGINEERING. (3-3 or 1-0*) Cr. 4 or 1*.
Prerequisite: 514. Cholvin, Engen, Kolde.
Mammalian physiology from an engineering point of view. Quantitative and comparative study of respiration, metabolism, acid-base balance, and endocrine functions. Emphasis on biological control mechanisms.

561. COMPARATIVE MAMMALIAN PHYSIOLOGY. (4-0 or 4-3) Cr. 4 or 5. F.
Prerequisite: Credit or classification in V. Anat. 304 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 in Physiology of body fluids, electrolytes, blood, excretion, and respiration.

* Graduate students from life science areas who are training in biomedical engineering but are enrolled in or have had V. Phys. 561, 562, 563 or equivalent may elect V. Phys. 515 for 1 credit.
562 COMPARATIVE MAMMALIAN PHYSIOLOGY.
(4-0 or 4-3) Cr. 4 or 5. W.
Prerequisite: 561. Koide, Picken.
Physiology of the nervous system, digestion, absorption, and metabolism

563. COMPARATIVE MAMMALIAN PHYSIOLOGY.
(4-0 or 4-3) Cr. 4 or 5. S.
Prerequisite: 562. Hembrough.

COURSES FOR GRADUATE STUDENTS, major or minor

604. SEMINAR.
Cr. 1. W.
Prerequisite: Permission of Instructor. Staff.
A student participation seminar in which graduate students present an oral and written review of an assigned topic.

660. DIGESTIVE PHYSIOLOGY.
(3-0) Cr. 3. Alt. S. Offered 1968.
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

WATER RESOURCES

Advisory Committee: Don Kirkham, Ph.D., Chairman; Roger W. Bachmann, Ph.D.; E. R. Baumann, Ph.D.; Russell J. Beers, Ph.D.; John D. Dodd, Ph.D.; Gordon E. Gatherum, Ph.D.; Keith M. Hussey, Ph.D.; Howard P. Johnson, Ph.D.; John F. Timmons, Ph.D.; Helen J. Van Zante, 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, Economics, Forestry, Geology, Household Equipment, 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.

WILDLIFE BIOLOGY

For descriptive of courses, see Zoology and Entomology.
ZOOLOGY AND ENTOMOLOGY

Oscar E. Tauber, Ph.D., Chairman of Department


Instructors: Harold A. Borchers, M.S.; Ross V. Bulkley, M.S.; Melvin W. Denner, M.S.; Charles J. Ellis, M.A.; Adela S. Elwell, M.S.; Hester Fassel, M.S.; Quentin C. Haning, M.S.

Opportunities for 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 aides, extension specialists, and as 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 fisheries biology, wildlife biology, entomology, general zoology, physiology, parasitology, embryology and in pre-medical, pre-dentistry, and pre-medical technology requirements. Undergraduate majors in this department usually include the following basic courses in their programs: 101, 102, 224, 227, 234, 274, 303, 307, 311, 355. As supporting work, undergraduate majors have found the following courses desirable: Gen. 301; Bot. 101, 310; Chem. 101, 102, 103, 334, 335; Psych. 101; Soc. 134; Math. 101, 102, 110; Stat. 201; Geol. 100; Phys. 111, 112, 113; Bact. 304; Econ. 241, 242.

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.

Opportunities for 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, 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 only: 307, 324, 402, 405, 447, 448, 464, 465, 470.

Index to field of work is given by the second and third figures of course numbers:

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<td>60-69</td>
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<td>70-79</td>
<td>Entomology</td>
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<td>90-99</td>
<td>Problems and Research</td>
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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.

101. PRINCIPLES OF ZOOLOGY.
(3-4) Cr. 5. F.W.S.SSI.
Principles of modern animal biology; introduction to molecular basis of life and organization of cells and tissues; interrelationships of structure and function in living systems.

102. THE ANIMAL KINGDOM.
(3-4) Cr. 5. F.W.S.SSII.
Phylogeny, classification, and animal organization demonstrated through a survey of major phyla; emphasis on selected animals important to man's welfare.

141. PRINCIPLES OF WILDLIFE CONSERVATION.
(3-0) Cr. 3. W.
Prerequisite: 101 or 102.
History and biological basis of fish and wildlife conservation

155. ELEMENTARY HUMAN PHYSIOLOGY AND ANATOMY.
(3-4) Cr. 5. F.W.S.SSII.
Prerequisite: High school chemistry credit or concurrent enrollment in Chem. 101 or 105. Harding.
Basic physiology and anatomy of human organ systems. Not accepted except by special permission for credit for student majoring in zoology.

224. COMPARATIVE ANATOMY.
(2-6) Cr. 4. F.W.S.
Prerequisite: 101, and 102 or V. Anat. 217.
Study of selected chordate types with emphasis on those not examined in general courses.

227. HISTOLOGY.
(2-6) Cr. 4. W.S.
Prerequisite: 224.
Microanatomy of animals in relation to function.

234. VERTEBRATE EMBRYOLOGY.
(3-6) Cr. 5. F.W.S.SSI.
Prerequisite: 101 and 102 or V. Anat. 217; 224.
Introduction to principles and mechanisms of embryonic development of vertebrates.

274. GENERAL ENTOMOLOGY.
(2-6) Cr. 4. F.S.SSI.
Prerequisite: 102; 101 recommended.
Structure, life history, habits and recognition of common insects, with interesting facts about their relations with man. Field trips.

301. ELEMENTS OF ANIMAL BIOLOGY.
(3-0) Cr. 3. F.W.
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 Zool. 101 or 102.
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<tr>
<th>Course Number</th>
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<th>Prerequisites</th>
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<tbody>
<tr>
<td>302</td>
<td>FIELD BIOLOGY.</td>
<td>(4-12) Cr. 4.SSI. Offered only at the Iowa Lakeside Laboratory; must be taken concurrently with Bot. 301. Animals in the field, with particular emphasis on their recognition and on collecting, preserving, and laboratory culture methods. May not be used as substitute prerequisite for advanced courses which list 101 or 102 as prerequisites.</td>
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<tr>
<td>303</td>
<td>ANIMAL EVOLUTION.</td>
<td>(3-0) Cr. 3. F.W.SSI. Prerequisite: 12 credits in Biol. including Zool. 102, 224 recommended. Origin and evolution of animal life, sources and interpretation of evidence; principles as demonstrated in the animal kingdom.</td>
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<tr>
<td>307</td>
<td>INVERTEBRATE ZOOLOGY.</td>
<td>(2-6) Cr. 4. S.SSI. Prerequisite: 101 and 102. Advanced study of invertebrates stressing classification, morphology, life history and evolutionary relationships. Field trips.</td>
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<td>311</td>
<td>INTRODUCTION TO PARASITOLOGY.</td>
<td>(3-3) Cr. 4. F.W. Prerequisite: 101, 102. Survey of major groups of animal parasites, biology and host-parasite relationships of parasitic protozoans, helminths, acarina, crustaceans, insects, and vertebrates.</td>
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<tr>
<td>324</td>
<td>HISTOLOGICAL TECHNIQUES.</td>
<td>(1-9) Cr. 4. F.W.S.SI. Prerequisite: 227. Methods of fixing, sectioning, mounting and staining tissues for microscopic study.</td>
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<tr>
<td>325</td>
<td>MAMMALIAN ANATOMY.</td>
<td>(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.</td>
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<tr>
<td>340</td>
<td>ORNITHOLOGY.</td>
<td>(2-6) Cr. 4. S. Prerequisite: 101 or 102. Biology, classification, and identification of major groups of birds, laboratory and field work, including one-day trips to major bird habitats.</td>
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<td>355</td>
<td>PRINCIPLES OF PHYSIOLOGY.</td>
<td>(2-6) Cr. 4. F.W.S.SI. Prerequisite: 101; Chem. 102 or 106; Chem. 334 recommended. Introduction to animal functions.</td>
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<tr>
<td>358</td>
<td>PHYSIOLOGY OF REPRODUCTION.</td>
<td>(2-3) Cr. 3. F.W.S. Prerequisite: 101 or 155. Physiological aspects of intra-uterine life, maternal-fetal relationships; reproductive hormones. Not open for credit to students who have had 234 or 434.</td>
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<tr>
<td>359</td>
<td>KINESIOLOGY.</td>
<td>(3-6) Cr. 5. F.W.S.SSI. Prerequisite: 101 or 102 or 155. Analysis of human motion in terms of skeletal, articular and muscular systems.</td>
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</table>

*Courses administered by the College of Agriculture. All others administered by the College of Sciences and Humanities.*
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

503. PRIMATE EVOLUTION. (3-0) Cr. 3. S. Prerequisite: 15 credits in Zool. Hicks. Relationships and developmental history of primates


507. ETHOLOGY. (3-3) Cr. 4. F. Prerequisite: 15 credits in Zool.; 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.


512. HELMINTHOLOGY. (2-6) Cr. 4. F; also (8-24) Cr. 8. SSI at Iowa Lakeside Laboratory. 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

528. ANIMAL CYTOLOGY. (3-6) Cr. 5. F. Prerequisite: 20 credits in Biol. including Zool. 355 and Gen. 301; permission of instructor; histological techniques recommended. Bryan. 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; micro-technique recommended. Bryan. 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. Arnold. 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. Arnold. Physiology of germ-cells, parthenogenesis, marking and grafting experiments on living embryos; tissue-culture techniques

550. COMPARATIVE ANIMAL PHYSIOLOGY. (3-6) Cr. 5. S. Prerequisite: 307 and 355; 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.SSII. Prerequisite: 224 or V.Anat. 304 or equivalent. 355; 1 quarter organic chemistry; 1 quarter college physics. Griffith. Special emphasis on vertebrate renal physiology with some cellular mechanisms 551 Blood, nervous system, muscle 552 Circulation, respiration, digestion. 553 Metabolism excretion, endocrinology.

555. GENERAL PHYSIOLOGY. (3-6) Cr. 5. F. Prerequisite: Math. 110; courses in college physics, organic chemistry, and plant or animal physiology. Dunham. Animal physiology from study of isolated cells and tissues.


* 570. INSECT RESISTANCE IN CROP PLANTS. (3-0) Cr. 3. Alt. W. Offered 1968. Prerequisite: 274 or equivalent; Gen. 301. Peters. Principles and mechanisms of insect control by host plant resistance

* 572. INSECT MORPHOLOGY. (2-9) Cr. 5. F. Prerequisite: 15 credits in Zool., including 274. K. Knight. Intensive study of the external and internal anatomy and histology of insects.

* 574. MEDICAL ENTOMOLOGY. (2-6) Cr. 4. S. Prerequisite: 15 credits in Zool., including 274 or equivalent. K. Knight. Identification, life histories and control of insects and near relatives attacking man, particularly those forms which are disease vectors. Field trips

Description of Courses


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 Zool. H. Knight. Review of literature and classical authors of zoology and entomology, nomenclators, rules of zoological nomenclature.


605. LIMNOLOGY. (3-6) Cr. 5. F. Prerequisite: 405 or permission of instructor. Bachmann. Physical, chemical and biological processes of lakes and streams and their relationships to biological productivity, ecological succession and water quality. Limnological research techniques. Field trips.

612. ADVANCED PARASITOLOGY. (3-0) Cr. 3. S. Prerequisite: 511, 512. Ulmer. Special phases in host-parasite relationships of parasitic protozoa, worms and arthropods.

627. ADVANCED HISTOLOGY. (2-6) Cr. 4. W.SSI. Prerequisite: 227, 234, 355. Bryan. Study of normal tissues with emphasis on functional relationships at cellular and supracellular levels.


654. COMPARATIVE ENDOCRINOLOGY. (3-0) Cr. 3. W. Prerequisite: 224 or V.Anat. 304 or equivalent; 335; 551 or 552 or 553; 1 quarter organic chemistry; 1 quarter college physics. Griffith.

655. INSECT PHYSIOLOGY. (3-0 or 3-6) Cr. 3 or 5. W. Prerequisite: 355 or 555; equivalent of 572 or permission of instructor. Mutchmor. Life processes, organ functions of insects.


663. FISHERIES RESOURCES. (3-0) Cr. 3. Alt. W. Offered 1969. Prerequisite: 465. Carlander. Survey of fishery resources; analysis of problems concerned with commercial and sport fisheries and their management.


Courses administered by the College of Agriculture. All others administered by the College of Sciences and Humanities.
THE TECHNICAL INSTITUTE

Agriculture, Louis M. Thompson, Ph.D., Head
Engineering Technology, Harold B. Ellis, Ph.D., Head
Food Service Management, Thomas E. Walsh, M.A., Head


Associate Professors: Joe V. Crawford, M.S.; Wilfred T. Hosmer, M.S.; James E. Humphrey, M.A.; Rudolph J. Lubsen, M.S.; Robert M. Nady, M.S.; Aldor C. Peterson, M.S.; C. Gordon Sanders, M.A.; 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 the Iowa State Technical Institute. 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.

Credits earned in the Technical Institute do not apply toward a Bachelor's degree.

Application for admission should be made to the Director of Admissions, 104 Beard-shear Hall, Iowa State University, Ames, Iowa 50010. For information about rooms, see Student Housing.

Students in the Technical Institute are considered as part of the University. They assume the same obligations, and pay the same fees and tuition as other University students.

The Technical Agriculture Program

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.
Description of Courses

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 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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*Adapted sports

The Engineering Technology Programs

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 engineering in the design, manufacture and construction of products and structures or in the operation of engineering 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 engineering technology a student normally must be a graduate of an approved high school and have completed successfully one and one-half units of high school algebra and one unit of high school geometry. Prospective students are urged to present additional high school credits in English, mathematics, physics and chemistry. Those who have not been graduated from an approved high school and who wish to make application for admission to an engineering technology program will be considered on an individual basis after completing certain tests and entrance examinations.

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

The engineering technology programs offer in some instances a work-study cooperative program so that the participating student may gain practical experience in engineering technology during his Technical Institute career. Each work-study program is arranged so the academic phases of engineering technology are taught at the campus and actual practice is gained by working in industry during alternate quarters of the second year. The student benefits from the work-study program by getting experience in his chosen technology, and by being able to evaluate a particular company as a possible employer, plus receiving a reasonable financial return. The company can evaluate the student's potential as a possible future permanent employee. The Technical Institute 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.
**Chemical Industries Technology**

Leading to the Associate in Applied Science. Total credits required, 106.

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**Second Year**

| **Credits**                       |                                     |                                     |
| Quantitative Chemical Analysis    | Technical Geometry                 | Letter and Report Writing           |
| Chem. 60                          | A. Gr. 45                           | Engl. 40                            |
| Basic Chemical Industries         | Instrumental Quantitative Analysis | Public Speaking                     |
| Ch. I Tch. 51                     | Chem. 61                            | Sp. 30                              |
| Unit Operations I                 | Unit Operations II                  | Unit Operations III                 |
| Ch. I Tch. 61                     | C. I Tch. 62                        | Ch. I Tch. 63                       |
| Power Applications                | Control Instruments                 | Process Control                     |
| E Tch. 81                         | Ch. I Tch. 71                       | Ch. I Tch. 72                       |
| Graphical Mathematics             | Survey of Accounting                | Process Layout                      |
| A. Gr. 47                         | I. Ad. 75                           | Ch. I Tch. 80                       |
| **Total Credits**                 | **Total Credits**                   | **Total Credits**                   |
| 17                                | 18                                  | 17                                  |

**Construction Technology**

Leading to the Associate in Applied Science. Total credits required, 117.

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<td>Structural and Building Drawing</td>
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<td>Hydraulics A.M. 33</td>
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#### Second Year

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#### Spring Quarter Credits

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<td>Applied Mathematics Math. 52</td>
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### Electronics Technology

Leading to the Associate in Applied Science. Total credits required, 110.
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<td>Systems Analysis</td>
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<td>E Tch 96</td>
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<td>Radio-Wave Fundamentals</td>
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<td>E Tch 92</td>
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<td>E Tch 83</td>
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### Winter Quarter

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### Mechanical Technology

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First Year

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Second Year

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The Food Service Management Program

The food service management program offers an opportunity to persons desiring preparation for middle-management career positions in food service. These include positions such as food service managers or assistant managers in restaurants, hotels, motels, industrial plants, department stores, social clubs, schools, colleges and universities, and other institutions. Positions offering supervisory responsibilities and challenges within a single food service organization are also available, as are sales positions with manufacturers and dealers of food, equipment, and other food service supplies. The technical program also provides preparation for an individual who is considering having his own restaurant or food service business.

The demand for well-trained food service technicians will continue to grow, both in Iowa and across the nation. Reasons for the growing demand include population increases, greater emphasis on tourism, increasing business competition causing more travel and entertainment by executives and salesmen, an increasing number of married women in the labor market, greater leisure time, and increasing use of food service facilities in industrial plants, schools, colleges and universities, hospitals, and government institutions.

In addition to the technical aspects of food production and service, the Technical Institute's course of study 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, 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, 101.

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COURSES OPEN TO TECHNICAL INSTITUTE STUDENTS ONLY

Agricultural Engineering

36. POWER SOURCES FOR AGRICULTURAL INDUSTRIES. (2-6) Cr. 4 W. Productive uses of gasoline engines and electrical power in agricultural enterprises. Principles and 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.

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 agrochemicals 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.

Applied Art

30. BASIC ART PRINCIPLES. (1-9) 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. Lettering, freehand sketching, use of scales and drawing instruments, theory of orthographic projection and pictorial drawing. Geometry of bearing, slope, true length and true size. Standards for sections, symbols and basic size specifications.

44. ELECTRICAL DRAWING. (1-6) Cr. 3 W.S. Prerequisite: 40. Applications of the principles of technical drawing and development of skills in pro-

45. TECHNICAL GEOMETRY.
(1-6) Cr. 3. W.
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.
(0-9) Cr. 3. S.
Prerequisite: 40.
Preparation of production drawings to be supplied to the shop or to be used wherever a product is manufactured, fabricated or erected. Specifications of size, shape, material, manufacture. Standard fastener specifications, including threads, welds, rivets, keys, splines and springs. Allowance specifications for mating parts and standards of surface quality. Graphical illustration for interpretation and presentation.

47. GRAPHICAL MATHEMATICS.
(0-6) Cr. 2. F.S.
Prerequisite: 40, credit or classification in Math. 52.

Chemical Industries Technology

10. INDUSTRIAL STOICHIOMETRY I.
(1-3) Cr. 2. W.
Prerequisite: Credit or classification in Chem. 30, Math. 50, Phys. 71.
Introduction to industrial stoichiometry.

11. INDUSTRIAL STOICHIOMETRY II.
(2-9) Cr. 1. S.
Prerequisite: 10 and credit or classification in Chem. 31, Math. 51, Phys. 72.
Engineering units and systems of measurement; material and energy balance calculations; industrial chemical problem solving techniques.

51. BASIC CHEMICAL INDUSTRIES.
(3-3) Cr. 4. F.
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.

61. UNIT OPERATIONS OF THE CHEMICAL INDUSTRIES I.
(2-8) 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.
82. UNIT OPERATIONS OF THE CHEMICAL INDUSTRIES II.  
(2-6) Cr. 4. W.  
Prerequisite: 61.  
Applications of filters, centrifugals, flotation and cyclones. Principles of heat transfer applied to heat exchangers, evaporators and dryers.

83. PROCESS LAYOUT II.  
(2-6) Cr. 4. S.  
Prerequisite: 62.  
Physico-chemical separation operations including absorption, distillation, extraction and crystallization.

80. 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.  
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 and use of surveying equipment. Chain, differential and profile leveling, traversing, errors of closure, computation of areas, stadia and its application to topographic mapping.

81. ROUTE AND CONSTRUCTION SURVEYING.  
(2-12) Cr. 6. S.S.  
Prerequisites: 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.

83. HIGHWAY AND MUNICIPAL DRAWING.  
(2-6) Cr. 4. F.  
Prerequisite: 81, 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 route construction work.

84. STREET AND HIGHWAY GEOMETRICS.  
(2-3) Cr. 3. W.  
Prerequisite: 83, 87.  
The use of geometrics in the design and layout of residential streets, county and state highways.

85. CONSTRUCTION METHODS I.  
(BUILDINGS).  
(2-3) Cr. 3. F.  
Prerequisite: 82.  
Methods of construction of steel, timber, and concrete structures in bridges, buildings, footings, retaining walls, tanks and towers. Forming and finishing of concrete, masonry work, paints and wood finishes. Quantity take-off for estimating purposes.

86. CONSTRUCTION METHODS II.  
(HIGHWAYS).  
(2-3) Cr. 3.  
Prerequisite: 83.  
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. ADVANCED SURVEYING.  
(2-12) Cr. 6. S.S.  
Prerequisite: 80, Math. 51.  
The general instructions for the subdivision of public land in the United States. Requirements 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.

90. SOILS TECHNOLOGY.  
(3-6) Cr. 5. W.S.  
Prerequisite: A.M. 31, Math. 52.  
The origin, structure, identification and classification of soils as used for engineering purposes. Soil moisture relationship, soil stabilization, bearing capacity, slope stability and pressure on retaining walls.

92. STRUCTURAL DESIGN (STEEL, CONCRETE AND TIMBER).  
(3-6) Cr. 5. W.S.  
Prerequisite: 82, A.M. 31, A.M. 32.  
Theory and design of steel, reinforced concrete, and timber structures, including beam design, connections, trusses, columns and footings.

94. PHOTOGRAMMETRY.  
(4-0) Cr. 4. S.  
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. F.  
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 of Federal, State and local governments. Taxation policies of Federal, State and local governments.

61. **FARM ACCOUNTS AND BUSINESS ANALYSIS.**  
(2-3) 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

80. **ELECTRONICS SHOP I.**  
(1-3) Cr. 2. W.S.  
Prerequisite: 85.  
Study of vacuum tube power supplies. Introduction to shop techniques and tools. Wiring and soldering techniques.

81. **POWER APPLICATION.**  
(3-2) Cr. 4. F.W.S.S.  
Prerequisite: 85 or Phys. 72 and Math. 51.  
Applications of electrical power to perform industrial operations. Performance characteristics and control of electric motors and machinery.

83. **ELECTRONICS SHOP II.**  
(1-6) Cr. 3. F.  
Prerequisite: 80, credit or classification in 93.  
Techniques and mechanics of building and installing electronic equipment. Familiarization with and comparison of available parts and tools and their use. Maintenance and trouble-shooting of electronic equipment.

84. **TECHNICAL DESIGN.**  
(2-9) Cr. 5. S.S.S.  
Prerequisite: English 40 and 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. **ELECTRIC CIRCUITS I.**  
(2-5) Cr. 4. F.W.  
Basic concepts of current and voltage. D.C., electric and magnetic circuits.

86. **ELECTRIC CIRCUITS II.**  
(2-5) Cr. 4. W.S.  
Prerequisite: 85, credit or classification in Math. 51.  

87. **ELECTRIC CIRCUITS III.**  
(2-5) Cr. 4. S.S.S.  
A.C. circuits. Electrical resonance, transistors, polyphase circuits and nonsinusoidal waveforms.

89. **BASIC ELECTRONICS.**  
(3-5) Cr. 5. S.S.S.  
Prerequisite: 80, credit or classification in 87.  
Fundamentals of vacuum tube circuits and devices. Consideration of manufacturer's data and standard component tolerances.

90. **DIGITAL COMPUTERS.**  
(3-2) Cr. 4. W.S.S.  
Prerequisite: Credit or classification in 93.  
Theory, practice and programming of digital computers. Applications of Boolean algebra to logical design.

92. **RADIO WAVE FUNDAMENTALS.**  
(3-3) Cr. 4. F.S.  
Prerequisite: Credit or classification in 93.  
Characteristics and properties of transmission lines, wave guides and antennas. Generation, propagation and reception of electromagnetic energy.

93. **ELECTRONICS I.**  
(3-2) Cr. 4. F.  
Prerequisite: 89.  
Introduction to semi-conductors and transistors. Design and analysis of transistor switching circuits.

94. **ELECTRONICS II.**  
(3-2) Cr. 4. W.  
Prerequisite: 93.  
Design and analysis of bias circuits and large signal amplifiers.

95. **ELECTRONICS III.**  
(3-2) Cr. 4. S.  
Design and analysis of small signal amplifiers, oscillators, and communication circuits.

96. **SYSTEMS ANALYSIS.**  
(5-0) Cr. 5. F.  
Prerequisite: 89.  
Transients in electrical and mechanical systems. Use of Laplace transforms in solving differential equations. Introduction to analog computer fundamentals and programming techniques.

97. **CONTROL SYSTEMS.**  
(3-2) Cr. 4. W.  
Prerequisite: 96.  
Introduction to feedback control system analysis. Use of Bode plots in the study of frequency characteristics of systems.
99. SPECIAL TOPICS.  
(3-2) Cr. 4. S.
Prerequisite: Permission of instructor.
A. Electronics.
B. Systems.
C. Computers.
D. Microwaves.
E. Industrial Electronics.

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.
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: F; 32: W.
Basic processes related to food preparation; factors relating to quality of food products.

33. APPLIED NUTRITION.  
(4-0) Cr. 4. S.
Prerequisite: 32.
Factors influencing daily food needs, habits and preferences. Guides for selection and use of food.

General Technology

10, 11, 12. TECHNICAL ORIENTATION.  
(1-0) Cr. R. 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 to observe engineering technicians at work in the student's chosen field of study.

14. TECHNICAL PROBLEMS I.  
(0-6) Cr. 2. F.W.

15. TECHNICAL PROBLEMS II.  
(0-3) Cr. 1. W.S.
Prerequisite: 14.
Importance of precision in mathematical work. Graphs and curve fitting. Practical application of trigonometric functions.

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.
A survey of the purposes and procedures of general accounting; introductory survey of cost accounting objectives and procedures. The course is designed to introduce students to the effective use of accounting information.

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) First 5 weeks. Cr. R.F.
Orientation of new students to Iowa State University and campus activities. Introduction to Technical Institute program and its relation 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.S.
Purpose of summer experience; arranging for employment; reporting of experience.

41. INTRODUCTION TO QUANTITY FOOD PREPARATION.  
(2-6) Cr. 4. S.
Prerequisite: F & N 32.
Basic food preparation principles and large quantity food production procedures.

61, 62. QUANTITY FOOD PRODUCTION PROCEDURES.  
(1-9) Cr. 4. 61: F; 62: W.
Prerequisites: 61: 41; 62: 41.
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.
Management functions as applied to an established food service operation.

84. PURCHASING FOOD PRODUCTS.  
(3-3) Cr. 4. W.
Prerequisite: 41.
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: 41.
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: 41 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: 62, 87, 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. S.
   Prerequisite: 61, 85, T & C 40.
   Considerations in selection of building materials and furnishings. Building maintenance procedures and equipment. Field trips required.

91, 92, 93. TECHNICAL INSTITUTE 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.

Courses in Mathematics

40. BASIC MATHEMATICS.
   (5-0) Cr. 5. F.W.S.
   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.; 51: W.S.; 52: S.SS.I.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 cones, differential and integral calculus

Mechanical Technology

75. MECHANICAL STANDARDS.
   (1-3) Cr. 2. F.SS.
   Prerequisite: A.Gr. 45.
   The origin and purpose of standards. Responsibility for development and maintenance of standards. Familiarization with the National Bureau of Standards, American Standards Association. ASME and other technical organizations which prepare standards in mechanical and allied fields. Detailed study of selected codes and standards

76. MECHANICAL PROCESSES I.
   (0-6) Cr. 2. F.W.S.
   Metal cutting operations. Basic machine tools. Planning and selection of the best method of producing parts by machine tools.

77. MECHANICAL PROCESSES II.
   (0-6) Cr. 2. F.W.S.

78. MECHANISMS.
   (4-0) Cr. 4. F.SS.
   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. METALLURGY I.
   (2-3) Cr. 3. W.S.
   Prerequisite: 77, 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. METALLURGY II.
   (2-3) Cr. 3. S.SS.
   Prerequisite: 79.

81. DESIGN TECHNOLOGY I.
   (2-6) 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 simple projects.

82. DESIGN TECHNOLOGY II.
   (2-6) Cr. 4. S.SS.
   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.

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.SS.
   Prerequisite: 85.
   Continuation of 85. Application of thermodynamics and flow relationships to the performance of machines and systems used for producing, transforming and applying heat and mechanical energy.
90. MEASUREMENTS LABORATORY.
   (1-6) Cr. 3. S.S.
   Prerequisites: 85, E.Tch. 81.
   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.

Physical Education

001-074. COURSES FOR TECHNICAL INSTITUTE PROGRAM

   Students enrolled would be integrated into all 100 numbered courses on this numbering basis, i.e., 001 would be consolidated with 101, 053 with 153 etc.

Physics

71. APPLIED PHYSICS I.
   (2-5) Cr. 4. F.W.
   Prerequisite: Credit or classification in Math. 50.
   Principles of measurement, kinematics, dynamics, mechanical energy and heat and geometrical optics with applications to engineering situations.

72. APPLIED PHYSICS II.
   (2-5) Cr. 4. W.S.
   Prerequisite: Phys. 71.
   Principles of statics, elasticity, fluids, electricity and magnetism and geometrical optics with applications to engineering situations.

73. APPLIED PHYSICS III.
   (2-5) Cr. 4. S.F.
   Prerequisite: Phys. 72 or credit or classification in E.Tch. 86.
   Principles of physical optics, thermodynamics, modern physics and energy conversion methods with application to engineering situations.

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. F.
   Basic principles of sociology for understanding society and man's behavior in groups.

Speech

30. PUBLIC SPEAKING.
   (3-0) Cr. 3. W.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

#### 1872–1966

<table>
<thead>
<tr>
<th>Degree Type</th>
<th>1864–1865</th>
<th>1872–1875</th>
<th>1875–1876</th>
<th>1876–1877</th>
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<tr>
<td><strong>Baccalaureate Degrees (total)</strong></td>
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<td>47,867</td>
<td>1,650</td>
<td>49,517</td>
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<tr>
<td>Present Curricula</td>
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<td>47,089</td>
<td>1,650</td>
<td>48,739</td>
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<td>Discontinued</td>
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<td>778</td>
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<td>778</td>
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<td><strong>Doctor of Veterinary Medicine (total)</strong></td>
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<td>71</td>
<td>2,552</td>
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<td><strong>Higher Degrees (total)</strong></td>
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<td>11,548</td>
<td>570</td>
<td>12,118</td>
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<td>Doctor of Philosophy</td>
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<td>3,233</td>
<td>208</td>
<td>3,441</td>
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<tr>
<td>Master of Engineering</td>
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<td>17</td>
<td>13</td>
<td>30</td>
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<td>Master of Landscape Architecture</td>
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<td>7,687</td>
<td>334</td>
<td>8,021</td>
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<td>Master of Vocational Education</td>
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<td><strong>Professional Degrees</strong></td>
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<tr>
<td>in Engineering</td>
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<tr>
<td>Master of Agriculture</td>
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</tr>
<tr>
<td>Master of Forestry</td>
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<td></td>
<td></td>
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</tr>
<tr>
<td>Master of Landscape Architecture</td>
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<td><strong>Honorary Degrees</strong></td>
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<td>Doctor of Agriculture</td>
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<td>Doctor of Laws</td>
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<td>51</td>
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<td>Doctor of Science</td>
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<td>Discontinued Higher Degrees</td>
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<td>61,896</td>
<td>2,291</td>
<td>64,187</td>
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<td><strong>All Degrees Conferred</strong></td>
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# Summary of Enrollment

## ENROLLMENT 1964-65

A summary of different individuals enrolled during the year.

<table>
<thead>
<tr>
<th>Academic Year</th>
<th>Fiscal Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sept 1964 - June 1965</td>
<td>June 1964 - June 1965</td>
</tr>
<tr>
<td><strong>Men</strong></td>
<td><strong>Women</strong></td>
</tr>
<tr>
<td>-------------------</td>
<td>-----------------</td>
</tr>
<tr>
<td>Grand total of all students</td>
<td>10935</td>
</tr>
<tr>
<td>Total of all students of college grade</td>
<td>10836</td>
</tr>
<tr>
<td>I Students in residence of college grade</td>
<td>10541</td>
</tr>
<tr>
<td>College of Agriculture</td>
<td>2405</td>
</tr>
<tr>
<td>College of Engineering</td>
<td>2578</td>
</tr>
<tr>
<td>Technical Institute</td>
<td>349</td>
</tr>
<tr>
<td>College of Home Economics</td>
<td>105</td>
</tr>
<tr>
<td>College of Sciences and Humanities</td>
<td>2910</td>
</tr>
<tr>
<td>College of Veterinary Medicine</td>
<td>258</td>
</tr>
<tr>
<td>Graduate College</td>
<td>2066</td>
</tr>
<tr>
<td>Total</td>
<td>10671</td>
</tr>
<tr>
<td>Duplicates</td>
<td>130</td>
</tr>
</tbody>
</table>

II Students not in residence of college grade extension, off-campus

<table>
<thead>
<tr>
<th><strong>First Term Only</strong></th>
<th><strong>Second Term Only</strong></th>
<th><strong>Twelve Weeks</strong></th>
<th><strong>Total</strong></th>
<th><strong>Summer &amp; Academic Year</strong></th>
<th><strong>Students Attending Summer Only</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Grand Total of All Students</td>
<td>1650</td>
<td>585</td>
<td>2322</td>
<td>4557</td>
<td>3165</td>
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<tr>
<td>Total of all students of college grade</td>
<td>1594</td>
<td>585</td>
<td>2322</td>
<td>4501</td>
<td>3141</td>
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<tr>
<td>I Students in residence of college grade</td>
<td>1650</td>
<td>585</td>
<td>2322</td>
<td>4557</td>
<td>3165</td>
</tr>
<tr>
<td>Agriculture</td>
<td>147</td>
<td>48</td>
<td>205</td>
<td>402</td>
<td>330</td>
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<td>Engineering</td>
<td>175</td>
<td>71</td>
<td>246</td>
<td>528</td>
<td>420</td>
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<tr>
<td>Technical Institute</td>
<td>48</td>
<td>2</td>
<td>50</td>
<td>55</td>
<td>45</td>
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<tr>
<td>Home Economics</td>
<td>271</td>
<td>57</td>
<td>328</td>
<td>536</td>
<td>391</td>
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<tr>
<td>Sciences and Humanities</td>
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<td>147</td>
<td>534</td>
<td>990</td>
<td>683</td>
</tr>
<tr>
<td>Veterinary Medicine</td>
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<td>Graduate</td>
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<td>254</td>
<td>776</td>
<td>1948</td>
<td>1259</td>
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<tr>
<td>Total</td>
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<td>580</td>
<td>2340</td>
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<tr>
<td>Net Total</td>
<td>1545</td>
<td>576</td>
<td>2319</td>
<td>4440</td>
<td>3111</td>
</tr>
</tbody>
</table>

II Students not in residence of college grade extension, off-campus

<table>
<thead>
<tr>
<th><strong>First Term Only</strong></th>
<th><strong>Second Term Only</strong></th>
<th><strong>Twelve Weeks</strong></th>
<th><strong>Total</strong></th>
<th><strong>Summer &amp; Academic Year</strong></th>
<th><strong>Students Attending Summer Only</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>1545</td>
<td>576</td>
<td>2319</td>
<td>4440</td>
<td>3111</td>
</tr>
</tbody>
</table>

III Students in residence not of college grade

<table>
<thead>
<tr>
<th><strong>First Term Only</strong></th>
<th><strong>Second Term Only</strong></th>
<th><strong>Twelve Weeks</strong></th>
<th><strong>Total</strong></th>
<th><strong>Summer &amp; Academic Year</strong></th>
<th><strong>Students Attending Summer Only</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Music, Driver training and nursery school</strong></td>
<td>99</td>
<td>133</td>
<td>232</td>
<td>114</td>
<td>162</td>
</tr>
</tbody>
</table>
## ENROLLMENT 1965-66

A summary of different individuals enrolled during the year

<table>
<thead>
<tr>
<th></th>
<th>Academic Year</th>
<th>Fiscal Year</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Sept 1965</td>
<td>June 1965</td>
</tr>
<tr>
<td></td>
<td>June 1966</td>
<td>June 1966</td>
</tr>
<tr>
<td></td>
<td>Men</td>
<td>Women</td>
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<tr>
<td>Grand total of all students</td>
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<td>Total of all students of college grade</td>
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<td>College of Agriculture</td>
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