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University Calendar/1973-1974

Fall Quarter 1973

Orientation Days
University Holiday, Offices Closed—
Registration—
Examinations to Secure Advance Standing or to Remove Incompletes—
Class Work Begins—
End of Fee Payment Period—
English Proficiency Examination—

Sept. 3, Mon.
Sept. 4, Tues.
Sept. 5, Wed.
Sept. 6, Thurs.
Sept. 11, Tues., 4 p.m.
Sept. 13, Thurs., 4-6 p.m.
Sept. 26, Wed.
Oct. 12, Fri.
Oct. 29, Mon.

University Holidays, Offices Closed—
Dec. 24, 25, Mon. and Tues.

University Holiday,
Offices Closed—
Jan. 1, Tues.
Class Work Resumes—
Jan. 7, Mon., 7 a.m.
Mid-quarter Reports Due—
Jan. 11, Fri.
Final Date for Indicating Intent to Graduate—
Jan. 11, Fri.
Last Day a Course May Be Dropped Without Exculvating Circumstances—
Feb. 1, Fri.
Spring Registration for Students Who Are in Residence Winter Quarter—
Feb. 15 and 18-21, Fri., and Mon.-Thurs.
Final Examinations—
Graduation—
Feb. 18-22, Mon.-Fri.
Feb. 23, Sat.

Winter Registration for Students Who Are in Residence Fall Quarter—
Nov. 9 and 12-15, Fri., Mon.-Thurs.
Nov. 12-16, Mon.-Fri.
Nov. 17, Sat.

Winter Quarter 1974

Examinations to Secure Advance Standing or to Remove Incompletes—
Registration for New and Re-entering Students*—
Class Work Begins—
End of Fee Payment Period—
English Proficiency Examination—

Nov. 26, Mon.
Nov. 26, Mon.
Nov. 26, Mon.
Nov. 28, Wed., 4 p.m.
Dec. 6, Thurs., 4-6 p.m.
Dec. 14, Fri.
Dec. 21, Fri., 6 p.m.

Last Day a Course May Be Dropped Without Recommendation of Instructor—
Christmas Recess Begins—

Mar. 4, Mon.
Mar. 4, Mon.
Mar. 4, Mon.
Mar. 6, Wed., 4 p.m.
Mar. 14, Thurs., 4-6 p.m.
Mar. 22, Fri.
Apr. 11, Thurs.
Apr. 11, Thurs.
Apr. 11, Thurs., 6 p.m.
Apr. 16, Tues., 7 a.m.
May 2-4, Thurs.-Sat. (tentative)
May 6, Mon.
May 17, Fri., 6 p.m.
May 20-21, Mon., Tues.
May 20-24, Mon.-Fri.
May 25, Sat.
May 27, Mon.
Summer Quarter 1974

First Session Registration—June 3, Mon.
Class Work Begins—June 4, Tues.
End of Fee Payment Period—June 5, Wed., 4 p.m.
Last Day a Course May Be Dropped Without Recommendation of Instructor—June 13, Thurs.
English Proficiency Examination—June 13, Thurs.
Last Day a Course May Be Dropped Without Extenuating Circumstances—June 27, Thurs.
University Holiday, Offices Closed—July 4, Thurs.
First Session Ends—July 9, Tues.

Second Session Registration—July 10, Wed.
Class Work Begins—July 11, Thurs.
End of Fee Payment Period—July 12, Fri., 4 p.m.
English Proficiency Examination—July 18, Thurs., 4 p.m.
Last Day a Course May Be Dropped Without Recommendation of Instructor—July 22, Mon.
Last Day a Course May Be Dropped Without Extenuating Circumstances—Aug. 5, Mon.
Graduation—Aug. 15, Thurs.

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

University Calendar/1974-1975

Fall Quarter 1974

Orientation Days
University Holiday, Offices Closed—Sept. 2, Mon.
Registration—Sept. 3, Tues.
Examinations to Secure Advance Standing or to Remove Incompletes—Sept. 4, Wed.
Class Work Begins—Sept. 5, Thurs.
End of Fee Payment Period—Sept. 10, Tues., 4 p.m.
English Proficiency Examination—Sept. 12, Thurs., 4-6 p.m.

Last Day a Course May Be Dropped Without Recommendation of Instructor—Sept. 25, Wed.
Mid-quarter Reports Due—Oct. 11, Fri.
Final Date for Indicating Intent to Graduate—Oct. 11, Fri.
Homecoming, Classes Dismissed at 12 noon Fri.—Nov. 1-4, Fri. p.m. to Mon. a.m.
Resume 12:10 p.m. Mon.—Nov. 15°, and 18-21, Fri. and Mon.-Thurs.

Final Examinations—Nov. 18-22, Mon.-Fri.
Graduation—Nov. 23, Sat.
University Holidays, Offices Closed—Nov. 28-29, Thurs. and Fri.

*Fall Quarter classes will end on Friday.

Winter Quarter 1975

Examinations to Secure Advance Standing or to Remove Incompletes—Dec. 2, Mon.
Registration for New and Re-entering Students—Dec. 2, Mon.
Class Work Begins—Dec. 2, Mon.
End of Fee Payment Period—Dec. 4, Wed., 4 p.m.
English Proficiency Examination—Dec. 12, Thurs., 4-6 p.m.

Last Day a Course May Be Dropped Without Recommendation of Instructor—Dec. 20, Fri.
Christmas Recess Begins—Dec. 20, Fri., 6 p.m.
University Holidays, Offices Closed—Dec. 24, 25, Tues.-Wed.
University Holiday, Offices Closed—Jan. 1, Wed.
Class Work Resumes—Jan. 6, Mon., 7 a.m.
Mid-quarter Reports Due—Jan. 17, Fri.
Final Date for Indicating Intent to Graduate—Jan. 17, Fri.

Last Day a Course May Be Dropped Without Extenuating Circumstances—Feb. 7, Fri.
Spring Registration for Students Who Are in Residence Winter Quarter—Feb. 21, 24-27, Fri., Mon.-Thurs.
Final Examinations—Feb. 24-28, Mon.-Fri.
Graduation—Mar. 1, Sat.
Spring Quarter 1975

Examinations to Secure Advance Standing or to Remove Incompletes—
Registration for New and Re-entering Students—
Class Work Begins—
End of Fee Payment Period—
English Proficiency Examination—

Mar. 10, Mon.
Mar. 10, Mon.
Mar. 10, Mon.
Mar. 12, Wed., 4 p.m.
Mar. 20, Thurs., 4-6 p.m.
Mar. 27, Thurs., 6 p.m.
Apr. 1, Tues., 7 a.m.
Apr. 1, Tues.
Apr. 11, Fri.
Apr. 11, Fri.
May 1-3, Thurs.-Sat. (tentative)
May 5, Mon.
May 19-20, Mon.-Tues.
May 19-23, Mon.-Fri.
May 24, Sat.
May 26, Mon.

Examinations to Secure Advance Standing or to Remove Incompletes—
Registration for New and Re-entering Students—
Class Work Begins—
End of Fee Payment Period—
English Proficiency Examination—

Easter Recess Begins—
Class Work Resumes—
Last Day a Course May Be Dropped Without Recommendation of Instructor—
Mid-quarter Reports Due—
Final Date for Indicating Intent to Graduate—
Veishea, Classes Dismissed 12 noon Thurs.—

Mar. 10, Mon.
Mar. 10, Mon.
Mar. 10, Mon.
Mar. 12, Wed., 4 p.m.
Apr. 1, Tues., 7 a.m.
Apr. 11, Fri.
Apr. 11, Fri.
May 1-3, Thurs.-Sat. (tentative)
May 5, Mon.
May 19-20, Mon.-Tues.
May 19-23, Mon.-Fri.
May 24, Sat.
May 26, Mon.

Summer Quarter 1975

First Session Registration—
Class Work Begins—
End of Fee Payment Period—
Last Day a Course May Be Dropped Without Recommendation of Instructor—
English Proficiency Examination—

Mar. 10, Mon.
Mar. 10, Mon.
Mar. 10, Mon.
Mar. 12, Wed., 4 p.m.
Apr. 1, Tues., 7 a.m.
Apr. 11, Fri.
Apr. 11, Fri.
May 1-3, Thurs.-Sat. (tentative)
May 5, Mon.
May 19-20, Mon.-Tues.
May 19-23, Mon.-Fri.
May 24, Sat.
May 26, Mon.

Last Day a Course May Be Dropped Without Extenuating Circumstances—
University Holiday, Offices Closed—
First Session Ends—
Second Session Registration—
Class Work Begins—
End of Fee Payment Period—
English Proficiency Examination—

June 2, Mon.
June 3, Tues.
June 4, Wed., 4 p.m.
June 12, Thurs.
June 12, Thurs., 4-6 p.m.
June 26, Thurs.
July 4, Fri.
July 8, Tues.
July 9, Wed.
July 10, Thurs.
July 11, Fri., 4 p.m.
July 17, Thurs., 4-6 p.m.
July 21, Mon.
Aug. 4, Mon.
Aug. 13, Wed.
Aug. 14, Thurs.
Administration of
Iowa State
University

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

State Board of Regents

Stanley F. Redeker, President
R. Wayne Richey, Executive Secretary

Terms expire June 30, 1973
Ned E. Perrin ......................................Mapleton
Stanley F. Redeker ..................................Boone
Ralph H. Wallace ..................................Mason City

Terms expire June 30, 1975
Ray V. Bailey ......................................Clarion
Mrs. H. Rand Petersen ..............................Harlan
Donald H. Shaw ......................................Davenport

Terms expire June 30, 1977
John Baldridge ......................................Chariton
Mrs. Robert M. Collision ..........................Oskaloosa
Ralph McCartney .....................................Charles City

Officers of Administration

William Robert Parks, Ph.D., President of the University
James H. Hilton, D.Sc., President Emeritus
George C. Christensen, Ph.D., Vice President for Academic Affairs
Carl Hamilton, B.S., Vice President for Information and Development
Wilbur L. Layton, Ph.D., Vice President for Student Affairs
Wayne R. Moore, B.S., Vice President for Business and Finance
Daniel J. Zaffarano, Ph.D., Vice President for Research; Dean of the Graduate College

Instruction and Research

Lee R. Kolmer, Ph.D., Dean of the College of Agriculture; and Director of the Agriculture and Home Economics Experiment Station
Virgil S. Lagomarcino, Ph.D., Dean of the College of Education; Director of Teacher Education
David R. Boylan, Ph.D., Dean of the College of Engineering
Helen LeB. Hilton, Ph.D., Dean of the College of Home Economics; Director of Home Economics Research Institute
Wallace A. Russell, Ph.D., Dean of the College of Sciences and Humanities; Director of the Sciences and Humanities Research Institute
Phillip T. Pearson, D.V.M., Ph.D., Dean of the College of Veterinary Medicine; Director of the Veterinary Medical Research Institute
Paul W. Petersen, Ph.D., Director of the Engineering Research Institute
Robert S. Hansen, Ph.D., Director of the Institute for Atomic Research
Herbert A. David, Ph.D., Director of the Statistical Laboratory
Clair G. Maple, Ph.D., Director of the Computation Center

Services

Arthur M. Gowan, Ph.D., Dean of Admissions and Records
Marvin A. Anderson, Ph.D., Dean of University Extension
C. Arthur Sandeen, Ph.D., Dean of Students
Charles F. Frederiksen, M.S., Director of Residence
Gail Proffitt, M.D., Director of the Student Health Service
Warren B. Kuhn, M.L.S., Dean of Library Services
Bernard O. Randol, B.B.A., C.P.A., Controller and Secretary
Warren R. Madden, M.B.A., Assistant Vice President for Business and Finance
Samuel A. McDowell, Treasurer
Delbert H. Ostermann, Director of Purchasing and Stores
Edgar P. Swanson, M.S., Supervisor of Student Loans and Scholarships
William W. Whitman, B.S., Director of Physical Plant
Bruce M. Abbey, B.S., Associate Personnel Officer
The Faculty

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


ABBEY, DUANE C., Instructor in Mathematics B.S., 1964, Iowa State; M.S., 1965, Notre Dame.

ABIAN, ALEXANDER, Professor of Mathematics B.S., 1945, Tehran (Iran); M.A., 1954, Chicago; Ph.D., 1955, Cincinnati.

ABRAHAM, WILLIAM H., Professor of Chemical Engineering B.S., 1952, Iowa State; M.A., 1957, Drake; Ph.D., 1961, Iowa State.

ABRAM, EDMUND, Associate in Economics B.S., 1957, Utah State.

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


AFFECTE, STEPHEN R., Associate in Agronomy B.S., 1960, Utah.

AHRENS, FRANKLIN A., Associate Professor of Veterinary Physiology and Pharmacology B.S., D.V.M., 1953, Kansas State; M.S., 1965, Ph.D., 1968, Cornell.

AIKMAN, JOHN M., Professor of Botany A.B., 1917, A.M., 1921, D.Sc., 1951, Nebraska Wesleyan; Ph.D., 1926, Nebraska.

ITCHISON, GARY L., Assistant Professor of Industrial Administration B.A., 1956, State College of Iowa; M.A., 1961, Colorado State; Ph.D., 1972, Iowa State.


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


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

ALQUIST, JAMES C., Assistant Professor; Area Director, University Extension B.S., 1934, M.S., 1936, Iowa State.

AMETYA, MINORU, Professor of Agronomy B.S., 1942, California; M.S., 1946, Ph.D., 1950, Ohio State.

ANDERSON, ARTHUR R., Associate in Veterinary Physiology and Pharmacology B.S., 1954, Loyola University.

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

ANDERSON, DALE A., Associate Professor of Aerospace Engineering B.S., 1957, St. Louis; M.S., 1969, Ph.D., 1964, Iowa State.


ANDERSON, ERNEST W., Professor of Aerospace Engineering; Anson Marston Distinguished Professor in Engineering B.S., 1928, North Dakota State; M.S., 1928, Ph.D., 1933, Iowa State.

ANDERSON, E. WALTER, Assistant Professor of Physics; Associate Physicist, Ames Laboratory—USAEc. A.B., 1969, Harvard; M.S., 1961, Ph.D., 1965, Columbia.

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

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

ANDERSON, LESLIE A., Instructor in Physical Education for Men B.S., 1930, M.S., 1934, Iowa State.

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

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


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

ANDREWS, JOHN A., Instructor in Veterinary Pathology, Veterinary Medical Diagnostic Laboratory. D.V.M., 1968, Iowa State.

ANGELICI, ROBERT J., Professor of Chemistry B.S., 1959, St. Olaf; Ph.D., 1965, Northwestern.

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


ARNAL, CARL A., Associate Professor of Engineering Graphics B.M.E., 1946, Minnesota; M.S., 1955, Kansas State; M.S., 1956, Iowa State.

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


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

ARNOLD, TOM A., Assistant Professor; Head, Circulation Department, Library B.S., 1958, Florida State; M.S., 1968, Oklahoma.

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

ARTHUR, L. W., Professor of Economics B.A., 1916, M.A., 1927, Iowa State; Ph.D., 1929, Minnesota.

ASHOUR, S.A.I.D., Associate Professor of Industrial Engineering Dipl Ing., 1955, "Technische Hochschule Miinchen"; M.S., 1954, Minnesota; Ph.D., 1967, Iowa.

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

ATKINS, RICHARD E., Professor of Agronomy B.S., 1941, Kansas State; M.S., 1942, Ph.D., 1949, Iowa State.

ATWELL, ROBERTA L., Assistant Professor of Secondary Education B.S. in Ed. 1933, Southwest Missouri State; M.Ed., 1956, Ed. D., 1972, Missouri.


AUSTIN, T. AL, Assistant Professor of Civil Engineering B.S.C.E., 1967, Texas Tech; M.S., 1970, Utah State; Ph.D., 1971, Texas Tech.

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

BECHTEL, CLAYTON C., Assistant Professor of Zoology and Entomology. B.S., 1965, California State Polytechnic (San Luis Obispo); Ph.D., 1971, California (Riverside).

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

BEITZ, DONALD C., Assistant Professor of Biochemistry; Assistant Professor of Animal Science. B.S., 1962, M.S., 1968, Illinois.

BELL, MELVIN B., Assistant Professor of Industrial Education. B.A., 1940, Northern Iowa; M.S., 1962, Iowa State.

BENDEIT, LINDA R., Instructor; Assistant Editor, Cooperative Extension Service. B.S., 1969, Iowa State; M.A., 1972, Northern Iowa.

BENEKE, RAYMOND R., Professor of Economics. B.A., 1940, M.S., 1946, Iowa State; Ph.D., 1948, Minnesota.

BENN, CHARLES L., Instructor; Photographer, Cooperative Extension Service.


BENNETT, PAUL C., Professor Emeritus of Veterinary Pathology. B.S., 1923, West Virginia; D.V.M., 1931, Ohio State.

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


BENSON, GAREN O., Assistant Professor of Agronomy. B.S., 1961, M.S., 1963, Minnesota; Ph.D., 1971, Iowa State.


BERARD, MICHAEL F., Associate Professor of Ceramic Engineering; Engineer, Ames Laboratory—USAEC. B.S., 1960, M.S., 1962, Ph.D., 1968, Iowa State.

BERESFORD, ROBERT, Professor Emeritus of Agricultural Engineering. B.S., 1924, A.B., 1941, Iowa State.

BERFORD, REX, Professor Emeritus of Animal Science. B.S., 1931, Iowa State.


BERGER, ROGER W., Associate Professor of Industrial Engineering. B.S.M.E., 1958, Nebraska; M.S.I.E., 1962, Kansas State; Ph.D., 1968, Alabama State.

BERGLES, MYRTLE E., Professor of Mechanical Engineering and Chairman of the Department. B.S., 1945, S.M., 1948, Massachusetts Institute of Technology.


BERNARD, ROBERT W., Associate Professor of Foreign Languages. B.A., 1958, St. Thomas; M.A., 1962, Ph.D., 1968, Kansas.


BERZON, JUDITH R., Instructor in English. A.B., Douglass College (Rutgers); M.A., New York.


BETZ, ELLEN L., Associate Professor of Psychology; Counseling Psychologist, Student Counseling Service. B.S., 1947, M.S., 1948, Minnesota.

BEVERIDGE, ELIZABETH, Professor Emeritus of Family Environment. B.S., 1929, Colorado State; M.S., 1934, Iowa State.


BISHOP, MARIE M., Assistant Professor; Assistant State Leader, 4-H and Youth Program, Cooperative Extension Service. B.S., 1942, Iowa State; M.S., 1950, Michigan State.

BLACK, CHARLES A., Professor of Agriculture; Charles F. Curtiss Distinguished Professor in Agriculture. B.S., 1937, Colorado State; M.S., 1938, Ph.D., 1942, Iowa State.

BLACK, HENRY M., Professor of Mechanical Engineering; Alcoa Professor. B.S., 1929, Iowa State; M.S., 1934, Harvard.


BLEYLE, CARL Q., Associate Professor of Music; University Musician. B.M., 1957, Kentucky; M.M., 1960, Wisconsin; Ph.D., 1963, Michigan State.

BLINN, EDMUND G., Associate Professor of Journalism and Mass Communication. B.S., 1948, Boston; M.S., 1950, Iowa State.


BOAST, WARREN R., Professor of Electrical Engineering and Head of the Department; Anson Marston Distinguished Professor in Engineering. B.S., 1933, M.S., 1934, Kansas; Ph.D. 1936, Iowa State.

BOCKHOLZ, CLARENCE W., Professor of Agricultural Engineering and Head of the Department. B.S., 1943, M.S., 1955, Ph.D., 1957, Iowa State.

BODENSTEIN, LEONARD J., Assistant Professor of Engineering. B.S., 1958, M.S., 1952, Iowa State.

BOEHMKE, GEORGE E., Associate Professor; Area Director, University Extension. B.S., 1943, M.S., 1953, Iowa State.


BOLES, DONALD E., Professor of Political Science. B.S., 1950, M.S., 1953, Ph.D., 1956, Wisconsin.

BOND, MIRIAM F., Assistant Professor; Head, Undergraduate Services, Library. B.A., 1954, Minnesota; M.A., 1954, Denver.

BOND, PAUL R., Associate Professor of Electrical Engineering. B.S., 1953, M.S., 1959, Ph.D., 1963, Iowa State.


BORTLE, FRANK E., Professor of Mathematics; Coordinator of Advising, College of Sciences and Humanities. B.S., 1934, M.S., University of Illinois; Ph.D., 1939, Iowa State.

BORTZ, WALTER R., Assistant Professor of Industrial Education. B.S., 1961, Bowling Green; M.A., 1965, Ball State; Ph.D., 1971, Ohio State.


BOWEN, CHARLES CLARK, Professor of Botany; Assistant Dean of the College of Sciences and Humanities. B.S., 1948, M.S., 1950, Ph.D., 1953, Michigan State.

BOWEN, DALE W., Associate Professor of Electrical Engineering. B.S., 1965, South Dakota School of Mines; M.S., 1966, Ph.D., 1968, Iowa State.

BOWEN, GEORGE H., Professor of Physics. B.S., 1949, Ph.D., 1953, California Institute of Technology.


BOWMAN, MICHAEL D., Instructor in Computer Science. B.S., 1966, Iowa State.

BOYD, DALE E., Assistant Professor of Journalism and Mass Communication. B.A., 1942, Iowa; M.S., 1970, Iowa State.


BOYLAN, DAVID JR., Professor of Chemical Engineering; Dean of the College of Engineering. B.S., 1943, Kansas; Ph.D., 1952, Iowa State.


BRATO, RITA, Assistant Professor of Sociology. B.S., 1956, San Jose State; M.S., 1967, Washington; Ph.D., 1970, Minnesota.

BRANDER, FRED A., Assistant Professor of Mathematics. B.A., 1921, Kansas State Teachers; M.S., 1923, Chicago.

BRANDT, FRANK E., Professor of Speech. B.A., 1938, Iowa State Teachers; M.S., 1948, Iowa State.

BRANT, GEORGE, Assistant Professor of Animal Science. B.S., 1953, M.S., 1965, Oklahoma State; Ph.D., 1971, University of California (Davis).

BRATTON, C. GENE, Assistant Professor of Journalism and Mass Communication. B.S., 1960, Missouri; M.S., 1968, Kansas.


BREALEY, HARRINGTON C., JR., Associate Professor of Electrical Engineering; Associate Professor of Computer Science. B.E.E., 1946, Georgia Institute of Technology; M.S., 1948, Ph.D., 1954, Illinois.

BREITER, JOHN C., Assistant Professor of Elementary Education. B.S., 1958, M.S., 1961, Mankato State; Ed.D., 1968, Northern Colorado.

BRENNER, JOHN M., Professor of Agronomy; Professor of Biochemistry. B.Sc., 1944, Glasgow (Scotland); Ph.D., 1948, D.Sc., 1959, London (England).

BREWER, RICHARD H., Associate Professor of Civil Engineering. B.S.C.E., 1960, M.S., 1961, Kansas State; Ph.D., 1963, Texas; M.L., 1967, M.D.

BREWER, WILMA D., Professor of Food and Nutrition and Head of the Department. B.S., 1936, Kansas State; M.S., 1939, Washington State; Ph.D., 1950, Michigan State.

BRINDLEY, TOM A., Professor of Entomology. B.S., 1928, M.S., 1929, Ph.D., 1934, Iowa State.


BROWN, DONALD W., Professor of Industrial Administration. B.S., 1942, Kansas State; M.A., 1946, Denver; C.P.A., 1950.

BROWN, E. DOUGLAS, Associate; Music Director, WOI AM-FM. B.A., 1960, Knox; M.A., 1962, Iowa.


BROWN, GEORGE GORDON, Associate Professor of Zoology. B.S., 1959, M.S., 1961, Virginia Polytechnic; Ph.D., 1966, Miami (Florida).


BROWN, L., Associate Professor of Veterinary Microbiology and Preventive Medicine, Veterinary Medical Diagnostic Laboratory. D.V.M., 1958, Ohio State; M.S., 1962, Ph.D., 1966, Iowa State.

BROWN, MILTON D., Associate Professor of Education. B.S., 1944, Central Michigan; M.B.A., 1962, Denver; Ph.D., 1964, Michigan.

BROWN, NANCY E., Associate Professor of Institution Management. B.A., 1960, Vermont; M.S., 1964, Kansas State; Ph.D., 1972, Iowa State.

BROWN, ROGER J., Associate Professor in Charge of Farm Operation. B.S., 1965, Iowa State.

BRUNER, CHARLOTTE R., Assistant Professor of Foreign Language. B.A., 1938, Illinois; M.A., 1939, Columbia.

BRUNER, DAVID K., Professor of English. A.B., 1934, Washington (St. Louis); Ph.D., 1941, Illinois.


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Benton County, Vinton

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

Cedar County, Tipton

Kenneth D. Muller, Director; *Sherri A. Gahring, Home Economist.

*Has multi-county responsibility

Iowa County, Marengo

Raymond L. McKean, Director; *Charlotte I. Smith, Home Economist.

Johnson County, Iowa City

Dale G. Shires, Director; *Martha B. Passmore, Home Economist; Larry P. Audiehelm, 4-H and Youth Leader.

Jones County, Anamosa

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

Linn County, Cedar Rapids

Richard T. Freeman, Director; *Cynthia A. Clossen, Home Economist; Susan H. Uthoff, Home Economist.
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Robert B. Hegland, Area Extension Director
  R. Lynn Benson, Extension 4-H and Youth Leader; James A. Cook, Extension Horticulture Specialist; Donald Lusch, Extension 4-H and Youth Leader; Errol D. Petersen, Extension Farm Management Specialist; Jay A. West, Extension Crop Production Specialist; Doyle R. Wolverton, Extension Livestock Production Specialist; Enid W. Wortman, Extension Consumer and Management Specialist.

Audubon County, Audubon
  David C. Fensek, Director.

Cass County, Atlantic
  A. Daniel Merrick, Director; LaVon M. Ebel, Home Economist; Mary E. Henningsen, 4-H and Youth Leader.

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Harrison County, Logan
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Mills County, Malvern
  LaVerne C. Obrecht, Director; Barbara J. Buffington, Home Economist.

Montgomery County, Red Oak
  Stanley L. Dunn, Director.

Page County, Clarinda
  Ronald C. Sanson, Director; Dorothy T. Keith, Home Economist.

Pottawattamie County, East, Oakland
  Donald D. Baker, Director.

Pottawattamie County, West, Council Bluffs
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  Charles E. Allen, Director.

Adams County, Corning
  James F. Kearns, Director.

Clarke County, Osceola
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Decatur County, Leon
  Ronald L. Benge, Director.

Madison County, Winterset
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Ringgold County, Mount Ayr
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The University

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

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

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

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

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

The Development of the University

Iowa was the first state to accept the terms of the Morrill Land-Grant Act. In March, 1863, the General Assembly awarded Iowa's grant to the recently chartered institution at Ames. The school opened its doors to a preparatory class in the fall of 1868. Instruction at the college level began the following March. A class of 26 was graduated at the first commencement in 1872. In the 12 months ending July 1, 1972, there were 3,992 baccalaureate or advanced degrees awarded, plus 111 certificates for special programs.

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

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

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

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

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

Accreditation, Sessions and Enrollment

The University is fully accredited by the North Central Association of Colleges and Secondary Schools, The National Council for Accreditation of Teacher Education, and is a member of the Association of American Universities.

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

In 1972 Iowa State had an enrollment of more than 19,000 and a faculty which numbered approximately 1,900.

Research and Service Agencies

Research is an important activity at Iowa State. Most faculty members engage in research pursuits as well as teaching. Graduate students, and in some cases undergraduates, receive stimulation which comes from being a part of the never-ending search for new knowledge. Therefore new developments and new ideas pervade the campus.

A year's operating budget for all research at the University is approximately $25 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.

An abbreviated description of the various research and service agencies and their administrative per-
personnel is here presented. Additional information concerning any of these organizations may be obtained from the offices located on the campus.

Agriculture and Home Economics Experiment Station—Lee R. Kolmer, director; John P. Mahlstedt, associate director; Solon A. Ewing, assistant director; Marguerite Scruggs, assistant director. In addition to the main station at Ames, experimental work is conducted at a number of outlying farms and in the fields of many farmer cooperators. Programs include both basic and applied research in all areas of agriculture and home economics.

Ames Laboratory of the United States Atomic Energy Commission—Robert S. Hansen, director; Velmer A. Fassel, deputy director; Adolf F. Voigt, assistant director. The laboratory staff conducts basic investigations which seek to discover new scientific knowledge and to improve understanding of natural laws and phenomena relevant to the release of nuclear energy. It prepares scientists for work in the nuclear and related fields through research appointments to Iowa State University graduate students.

Center for Agricultural and Rural Development—Earl O. Heady, director; A. Gordon Ball and Leo V. Mayer, associate directors. The staff conducts research and related activities relating to income, policies, employment, structure and development of agriculture and rural communities.

Computation Center—Clair G. Maple, director; Robert M. Stewart, associate director; Dale Grosvenor, assistant director; C.C. Mosier, assistant director. The Center provides an all-University computing service and a centralized facility for research and education in the computer sciences.

Engineering Research Institute—Paul W. Peterson, director; George K. Serowy, assistant director. The Institute coordinates staff research in areas involving all engineering academic departments and maintains major laboratories and technical service groups to support the various research programs. Funds are derived from state appropriations and from industrial and government grants or contracts. Activity is largely directed toward graduate instruction.

Home Economics Research Institute—Helen LeB. Hilton, director; Marguerite Scruggs, associate director. The staff of the institute conducts research as a part of the various programs in the College of Home Economics.

Industrial Relations Center—Harold W. Davey, director. The central focus of research is on the behavior of individuals and organizations in an employment and labor force relationship. It provides an interdisciplinary approach to related studies.

Institute for Atomic Research—Robert S. Hansen, director; Velmer A. Fassel, deputy director; Adolf F. Voigt, assistant director. The institute coordinates and administers programs in fundamental atomic energy and related research programs. Its staff and facilities are made available to those whose work requires the application of nuclear techniques.

North Central Regional Center for Rural Community Development—Earl O. Heady, director; A. Gordon Ball and Leo V. Mayer, associate directors. The Center is financed by the land grant universities of the North Central Region and the staff conducts research and related activities in cooperation with personnel of other universities on problems of rural community development, change, and welfare.

Nutrition Sciences Council—Vaughn C. Speer, chairman. The Nutrition Sciences Council promotes coordination of research and teaching programs in the nutrition sciences, appraises course offerings in nutrition sciences with recommendations for updating and integrating them, develops symposia on topics of national and international interest, sponsors interdepartmental seminars, and solicits training and research grants.

Sciences and Humanities Research Institute—Wallace A. Russell, director. The institute sponsors and administers research programs throughout the College of Sciences and Humanities.

Statistical Laboratory—Herbert A. David, director. 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 through on-campus consulting.

Veterinary Medical Diagnostic Laboratory—Vaughn A. Seaton, head. The laboratory provides a facility to which the Iowa animal industry and veterinary medical profession can bring animal health problems for counsel and diagnostic assistance.

Veterinary Medical Research Institute—Phillip T. Pearson, director; Melvin S. Hofstad, acting associate director. The Institute is multidisciplinary with a responsibility to conduct research and offer research training in comparative medicine. Research and research training are conducted in the areas of infectious diseases of animal and man as well as in basic biology.

Water Resources Research Institute—Don Kirkham, director; Daniel J. Zaffarano, administrative adviser. The Institute receives money and recommends its allocation for research in all aspects of water resources. It has been designated by the United States Department of Interior to receive funds for the State of Iowa under the Water Resources Research Act of 1964.

World Food Institute—George C. Christensen, coordinator. In July 1972, Iowa State established the World Food Institute as a world center of food research and education within the University.

The World Food Institute will focus on interrelationships between the United States and developing countries in understanding and solving the world's food problems. An attempt will be made to use the research results to make concrete policy recommendations to improve the world's food availability and consumption. In addition, the implications of the world's food problems on the United States and Iowa will be analyzed.
University Extension

Marvin A. Anderson, Dean

Through the combined University Extension program, the total resources of Iowa State can be brought to bear on urban and rural problems. University Extension includes all extension programs emanating from Iowa State. Most of the efforts are organized through the following agencies:

Cooperative Extension Service in Agriculture and Home Economics—Marvin A. Anderson, director. Among the programs offered 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.

Engineering Extension—R. E. Patterson, Jr., director. Both noncredit courses and video-taped graduate-credit courses taught by faculty members from the College of Engineering are offered throughout the state.

Center for Industrial Research and Service (CIRAS)—Waldo W. Wegner, director. This facility on the campus provides counsel and assistance to Iowa industry.

Extension Courses and Conferences—George H. Ebert, leader. Extension courses, off-campus university credit courses, and informal continuing education programs are offered as part of the broad educational and service base of the University.

Admission and Registration

Arthur M. Gowan, Ph.D., Dean of Admissions and Records
Fred C. Schlunz, M.S., Associate Dean and Registrar
Karsten Smedal, B.S., Acting Director of Admissions
Maurice Geist, M.A., Associate Director of Admissions
Robin Jackson, M.A., Assistant Director of Admissions
William Yungclas, B.S., Assistant Director of Admissions
John V. Sjoblom, M.A., Associate Registrar
Dean Nelson, M.A., Assistant Registrar
Herman Richtsmeier, M.S., Assistant to the Registrar
Vernie E. Hawkins, B.S., Admissions Counselor
Robert L. Hitzhusen, B.S., Admissions Counselor

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

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

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

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

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

Admission Requirements

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

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

General Requirements

A. ADMISSION OF FRESHMAN STUDENTS

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

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

1. A graduate of an accredited high school or its equivalent 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 nonapproved 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 other 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 who are not residents of Iowa may be expected to have maintained a 2.25 grade index.

c. A student who is below the above standard may be permitted to take entrance examinations. If the applicant successfully completes the examinations, he may be admitted on probation.

d. In general, transfer applicants under academic suspension from the last college attended will not be considered for admission during the period of suspension or, if for an indefinite period, until six months have passed since the last date of attendance. When eligible for consideration, the applicant will be considered as in the "C" average category.

e. A transfer applicant under disciplinary suspension will not be considered for admission until a clearance and a statement of the reason for suspension is filed from the previous college. When it becomes proper to consider an application from a student under suspension, Iowa State University must take into account the fact of the previous suspension in consideration of the application. An applicant granted admission under these circumstances will always be on probation and his admission subject to cancellation.

f. Applicants for admission by transfer who do not meet the standards may be denied.

g. Transfer credit from a junior college will not be accepted if that credit is earned after the total number of hours of credit accumulated by this student at all institutions attended exceeds one-half of the number of hours needed to earn the baccalaureate degree.

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

C. APPLICATION DEADLINES

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

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

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

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

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

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

2. Residence for Tuition Purposes. Regulations regarding residence for admission, fee, and tuition purposes are generally divided into two categories—those that apply to students who are residents and those that apply to students who are over 19 years of age. The requirements in these two categories are different. Domicile within the state means adoption of the state as a fixed permanent home and involves personal presence within the state. The two categories are discussed in more detail below.

3. Students Who Are Minors. The residence of a minor shall be determined by the facts at all times, except in extremely rare cases where emancipation can be proved beyond question. The residence of the father during his lifetime, and after his death, the residence of the mother, is the residence of the unemancipated minor; but if the father and the mother have separate places of residence, the minor takes the residence of the parent with whom he lives or to whom he has been assigned by court order. The parents of a minor applying for admission will be considered residents of Iowa only if they have a domicile within the state at the time of the beginning of the semester or quarter in which the minor is first enrolled at Iowa.

*Application deadline for fall quarter is August 1.

*Examinations for the determination of general competence to do college work are determined by the Regent Committee on Educational Relations and are comparable for all three state institutions. Competence established at one is acceptable at all three, but due to different specific curricular requirements, does not guarantee admission to either of the other two.
State University or the State University of Iowa, or University of Northern Iowa, and if the parents establish such domicile for purposes other than to qualify their child for resident tuition.

A minor admitted before his parents have moved to Iowa may be reclassified as a resident at the beginning of the next semester or quarter in which the student is enrolled, after his parents have established a domicile in Iowa. A minor student whose parents move to Iowa from another state before the time he reached 19 years of age or over and a domicile in Iowa, if he moved to Iowa by living in the state for at least 12 consecutive months immediately preceding registration may be eligible for resident status, if the student is enrolled after the date of the parent's removal from the state.

A minor under legal guardianship shall not be granted resident status until the time the minor child with legal residence in Iowa shall be considered to be a nonresident at the beginning of the next semester or quarter in which the student is enrolled after the date of the parent's removal from the state.

5. General Facts. The resident status for admission, fee, and tuition purposes of a married student shall usually be determined under those rules irrespective of the classification of the spouse. Married students under 19 years of age shall be considered to have attained legal age as of the date of their marriage.

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

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

Ownership of property in Iowa, or the payment of Iowa taxes, does not in itself establish residence.

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

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

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

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

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

Charge of classification from nonresident 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 resident status of a student for admission, fee, and tuition purposes may be appealed to a Review Committee. The findings of the Review Committee may be appealed to the Board of Regents.

Specific Requirements

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

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

2. Graduate Students—See Graduate College Admissions Requirements.

For the curricula in the College of Education one unit of algebra is required. The high school curriculum includes one year of algebra, and must include a year of English, one year of science, and one year of social studies, and must reflect a broad general background.

College of Engineering—One unit of geometry and one and one-half units of algebra are required. Students who have not completed all of the required mathematics courses may take geometry or third-semester algebra at Iowa State University. The requirements for admission to agricultural engineering are the same as for the college of engineering.

College of Education—For the curricula in the College of Education one unit of algebra is required. The high school curriculum includes one year of algebra, and may include a year of trigonometry or geometry, and/or three units of the sciences, one of which must be in English.

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 Admissions Requirements.

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Health Examination

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

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

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

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

Orientation

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

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

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

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

Summer Orientation

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

The specific procedures vary somewhat according to the college the student is entering.

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

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

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

Fall Orientation (New Student Week)

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

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

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

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

Registration

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

If a student wishes to initiate registration within the period between the 7th and 14th calendar day after classes begin for a quarter, he must obtain
written permission from the instructor(s) under whom he will be taking work and the approval of the dean of the college in which he will be registered. Registration for any quarter will be closed 14 calendar days after classes begin.

For either summer session the 7th and 14th calendar day would be replaced by the 4th and 7th calendar day.

Classification

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

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

Transcript of Record

One transcript of a student's academic record is provided without charge, upon request, to each student. Each additional single copy beyond the first is $2. In multiple orders, following the first copy for which no charge is made, the first additional copy charge is $2, and additional copies are 50 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 most courses taught in the University, provided he can show to the satisfaction of the department head concerned and his dean that he has made the necessary preparation. This may have been through high school courses or independent study. If the student meets the standard of the department in the course in which he is being examined, the credit will become a part of his University record. A grade of T is recorded and does not become a part of the student's cumulative average.

Credit for Military Service

1. Credit may be allowed in military science for service in a branch of the armed forces to the extent that such service approximates the courses in military science offered at Iowa State. Inquiry should be made to the appropriate military department regarding the procedure for securing credit. This will usually be done by a test out examination and results reported to the Office of Student Records.

Students with active military service who wish to complete the requirements for a commission while enrolled at Iowa State should contact the appropriate military department.

2. Credit will be allowed for college courses completed through the Armed Forces Institute by correspondence study, subject to the usual rules involving credits of this nature.

3. Credit will be awarded for successful completion of technical or specialized schools attended while on active duty with the armed forces to the extent that the material is applicable toward degree requirements at Iowa State. Application for such credit is made at the Office of Admissions. The admissions office is guided by the recommendations that are set out in the American Council on Educational publications, "A Guide to the Evaluation of Educational Experience in the Armed Services."

Fees and Expenses

All fees and expenses listed in this catalog were effective as of September 1, 1972. 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):
52 FEES AND EXPENSES

Iowa Resident

<table>
<thead>
<tr>
<th>Service</th>
<th>Amount</th>
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<tbody>
<tr>
<td>Registration fee</td>
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<tr>
<td>Tuition</td>
<td>--</td>
</tr>
<tr>
<td>Board and room</td>
<td>$870</td>
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<tr>
<td>Books, supplies and equipment</td>
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Nonresident

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<tr>
<td>Tuition</td>
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</tr>
<tr>
<td>Board and room</td>
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<td>Books, supplies and equipment</td>
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<tr>
<td><strong>Total</strong></td>
<td><strong>$2250</strong></td>
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</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

Iowa Resident

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

Nonresident

<table>
<thead>
<tr>
<th>Service</th>
<th>Undergraduate</th>
<th>Graduate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Per quarter</td>
<td>$410</td>
<td>$410</td>
</tr>
<tr>
<td>Per summer session</td>
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<td>205</td>
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<td>Light classification, fee per hour</td>
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<td>50</td>
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<tr>
<td>Fee reduction</td>
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<tr>
<td>0 or no credit course, fee per course</td>
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<td>150</td>
</tr>
<tr>
<td>R credit course, fee per course</td>
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</tr>
<tr>
<td>Reinstatement after registration cancellation</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td><strong>Audit</strong></td>
<td><strong>Light</strong></td>
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<tr>
<td>Off-campus</td>
<td><strong>Same</strong></td>
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<tr>
<td>In absentia</td>
<td><strong>Same</strong></td>
<td></td>
</tr>
<tr>
<td>Interim Fee</td>
<td><strong>Same</strong></td>
<td></td>
</tr>
</tbody>
</table>

Private Music Instruction

University students, per quarter
- 10 lessons per quarter: $30
- 20 lessons per quarter: $50
- Electric organ practice: $10
- Pipe organ practice: $15

Nonuniversity students, per quarter
- 10 lessons per quarter, 1 credit: $33
- 20 lessons per quarter, 2 credits: $55
- Electric organ practice: $10
- Pipe organ practice: $15

Special Students and Noncollegiate Students

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

Registration Fee For Graduate Students With Fee Reductions

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

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

Application Fee

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

Late Registration

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

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

Senior Fee

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

Refunds

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

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

Room and Board charges—Ten percent is deducted for each week or portion of a week that the student is in residence.

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

Student Housing

Charles F. Frederiksen, M.S., Director of Residence; Richard S. Holtz, M.S., Assistant Director of Residence; Gary Schwartz, M.A., Assistant Director of Residence; Daniel A. Hallenbeck, M.A., Assistant Director of Residence; Carlton T. Moen, M.S., Assistant Director of Residence; Thomas E. Walsh, M.S., Assistant Director of Residence; Robert J. Benson, M.S., Assistant to the Director of Residence; L. Richard McFarlin, Residence Hall Accountant; Lowell C. Shuman, Manager of Food Stores; William H. Willroth, Manager of Maintenance; Robert E. Fulwider, M.S., Program Adviser; Lynn B. Ruth, M.A., Program Adviser; Mary V. Parish, M.A., Program Adviser; Ronald J. Zera, M.A., Program Adviser; Edward M. Myers III, M.S., Program Adviser; David M. Vavroch, B.A., Program Adviser.

The University provides housing facilities for approximately 3,500 single undergraduate women, 4,600 single undergraduate men, 1,350 married students, 272 single graduate men and 118 single graduate women. Chapter houses are maintained near the campus by 36 fraternities and 14 sororities. They house approximately 3,100 students. Other students live in private rooms and apartments in Ames or nearby communities.

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

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

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

Undergraduate Residence Halls

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

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

Cafeteria-style food service is provided for all residents in the halls.

A single student who resides in an undergraduate residence hall signs a contract for room and board for the academic year. All charges are subject to change, but the rate for the academic year starting September, 1972, was $870.

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

Graduate Residence Hall

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

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

The room rate as of September 1972 was $130 per quarter in a double room, or $170 per quarter in a single room. A meal ticket may be purchased for $178 per quarter (as of September 1972) to eat in a residence hall dining room.

Married Student Housing

The University provides 500 apartments in University Village, 196 apartments in Hawthorn Court and 666 apartments in Pammel Court for student families. Rates for these apartments as of September 1972 are $100 per month in University Village, $85 per month in Hawthorn Court and $40 per month in Pammel Court. Apartments are unfurnished except for ranges and refrigerators in University Village and Hawthorn Court. Water Service and garbage removal are included in the rental. The tenant pays for his own gas, electricity and telephone.

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

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

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

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

Off-Campus Housing For Single Students

Availability and cost are factors to be considered when living off-campus as the number of good living quarters is limited. Sleeping rooms and apartments in older houses make up the bulk of off-campus housing.

The single off-campus Housing Office, 1212 Friley Hall, keeps a partial listing of off-campus sleeping rooms. Other housing may be obtained through real estate agents, local newspapers, or by contacting individual owners.

It is best that the student come to Ames well in advance of the time he plans to begin academic work as many rooms and apartments are rented 3 to 6 months in advance. Because of the variety, it is best to contact the owner directly to make arrangements for housing that will fit your requirements.

The single room rental rates average $10 per week; the double room rental rates average $8 per person per week. The student usually furnishes his own bed linens, towels, and study lamp. Board for students living in off-campus rooms may be obtained in residence hall dining rooms, private restaurants or the Memorial Union. Average rental rate per student sharing an apartment or house is $50 per month.

Student Services

The University Library

Warren B. Kuhn, M.S., Dean of Library Services

The University Library collection affords open-shelf access to a million volumes. Additional holdings of more than 500,000 microfilms and other microtext materials are available in a wide range of subject areas. The Library is particularly strong in the basic and applied fields of the biological and physical sciences and has embarked on a program of strengthening collections in the humanities and social sciences. Very complete holdings of periodicals are maintained in botany, chemistry, entomology, mathematics, physiology, and veterinary medicine. The Library receives over 15,000 journals and other serial publications, amounting to world coverage in many scientific fields in major and minor languages.

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

Exhibits of new books in all subjects are maintained on open-shelf display on the main floor. Current numbers of selected periodicals are displayed in the Periodical and Newspaper Room. Special exhibits of books, posters, photographs, art work, and other materials are scheduled for display during the academic year.
Student Counseling Service
Roy E. Warman, Ph.D., Director

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

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

Student Health Service
Gail McClure Profitt, M.D., Director

The University maintains a well-equipped hospital and dispensary for the care of students. Routine medical advice and treatment are given through the dispensary without charge. Medicines and services such as X-ray are provided at cost. Hospital service is at a nominal rate, but full fees for special nurses or consulting physicians are paid by the student. Special diets for such conditions as diabetes and ulcers are served at a diet table at the hospital.

The University physicians are authorized to exclude from the residence halls and classrooms any persons afflicted with a contagious disease and, if necessary, those coming in contact with such disease.

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

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

Office of the Dean of Students
C. Arthur Sandeen, Ph.D., Dean of Students
Thomas Goodale, Ph.D., Associate Dean of Students; Marita Jones, M.Ed., Assistant Dean of Students; Robert Lott, M.S., Assistant Dean of Students; J. Terry Jones, M.A., Special Projects Coordinator; Jean Palmer, M.S., Orientation Coordinator; Willis Bright, M.A., Program Adviser; Robert Denson, M.S., Program Adviser; Jodee Rottler, M.S., Program Adviser; Ron Hill, M.S., Fraternity Adviser; Nancy Kaible, B.S., Panhellenic Adviser.

One of the main functions of Iowa State University is the development of students as self-actualizing persons. The staff of the Dean of Students office, therefore, feels that its role is to assist and encourage this development. The staff, like the student body, is composed of individuals. This diversity allows it to participate in a wide variety of means in the process of student development. The staff input consists not only of individual counseling, but also of work with various groups, formal classes, and a great variety of established and innovative campus programming.

Each of the individual efforts has as its focal point at least one of the three following considerations: first, assisting the individual student in his or her search for personal meaning and worth; second, maintaining the university as a viable and responsive alternative for these experiences; and third, creating an awareness of the individuals' roles in, and responsibilities to, the total society. For example, the staff works with leaders of campus organizations, members of the greek-living systems, students living outside of organized housing, foreign students, church groups, various educational programs, and several social and activity oriented programs.

Foreign Student and Visitor Services
Eugene Clubine, M.S., Assistant to Vice President for Academic Affairs, Assistant Dean of Students, and Coordinator, Office of Foreign Student and Visitor Services.
Dorothy Foley, M.S., Associate Coordinator; Martin Limbird, M.S., Assistant Coordinator; Dennis Peterson, M.A., Program Assistant; Louise Rosenfeld, B.S., Program Assistant; Clara Simerville, Ph.D., Program Assistant; Dafnis Panagides, M.S., Program Assistant.
The Office of Foreign Student and Visitor Services assists foreign students with problems arising from legal, immigration, or personal matters; assists American students in applying for Fulbright, East-West Center, and other educational grants; provides information for studying, teaching, and working opportunities abroad for both teachers and students; involves itself in the coordination of activities between the community, U.S. students and foreign students; and coordinates the itineraries of foreign visitors and staff members whose professional interests coincide with teaching and research programs at Iowa State University.

Financial Aid

Edgar Swanson, M.S., Coordinator of Financial Aids
Michael White, M.S., Associate Coordinator; Lynnette Reed, B.S., Assistant Coordinator; William Bogue, M.S., Assistant Coordinator; Bryan Van Deun, A.B., Assistant Coordinator.

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

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

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

High Scholarship Recognition Awards

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

Scholarships

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

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

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

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

Educational Opportunity Grants

Title IV of the Higher Education Act of 1965 initiates a program of Educational Opportunity Grants, through institutions of higher education, to assist in making available the benefits of higher education to qualified high school graduates of exceptional financial need who for lack of means of their own or their families would be unable to obtain these benefits without such aid. Students who feel they may qualify for such a grant must have their parents file a Parents' Confidential Statement and be admitted to the University by March 1. Further information on these grants may be obtained by writing the Office of Student Financial Aids, Room 12, Beardshear Hall. Parents' Confidential Statements are available at the high schools.

Student Employment Opportunities

The University offers opportunities for student employment on a part-time basis during the academic year. A variety of jobs are available that allow a student to fit work into his schedule. If a student is interested in part-time employment, a visit to the Student Financial Aids Office should be arranged. The office is a job referral service, but is not a placement agency.

The University participates in the federally funded College Work-Study Program. Preference for Work-Study jobs is given to students from low-income families, but other students whose confidential state-
ment indicates financial need may also participate in the program.

Current job listings are maintained for the convenience of students by the Student Financial Aids Office, Room 12, Beardshear Hall. Further employment possibilities may exist within various academic departments. For those interested it is recommended that inquiry be made to individual departments. Students interested in food service employment can inquire about openings in advance of campus arrival. Write in care of the dietician of the residence hall to which you are assigned.

As student employment is considered a financial aid resource, preference is given to student applicants with demonstrated financial need.

### Student Loan Funds

Long-term loans, to be repaid after graduation or withdrawal from the University, are available through the University Loan Program or the Direct Student Loan Program (formerly National Defense Loan).

The amount loaned from these programs is determined by need, availability of funds, and satisfactory academic standing. Due to the need requirement, it is essential that a student file a confidential financial statement.

Emergency loan funds are available during registration periods, at a small interest rate. No advance application is necessary. The student must state the use of the loan, be in good academic standing, have completed at least one quarter at the University, and must repay the loan no later than the end of the same quarter in which the loan was made.

All loans must be made for educational purposes; i.e., tuition, room, board, books, and related costs.

### Student Aid Funds

Student aid funds, which are limited in size and number, require no interest from the borrower. These funds include the Mary Huncke Student Loan Fund and the John Baylor Loan Fund.

The following is a list of active loan funds available to Iowa State students. New loan funds are started frequently. Applications are made at the Office of Student Financial Aids, Room 12, Beardshear Hall, and require a confidential financial statement.

### ISU Loan Funds

<table>
<thead>
<tr>
<th>FUND</th>
<th>YEAR BEGUN</th>
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</thead>
<tbody>
<tr>
<td>R.M. Allen</td>
<td>1955</td>
</tr>
<tr>
<td>Alumni</td>
<td>1969</td>
</tr>
<tr>
<td>Merrill Anderson</td>
<td>1970</td>
</tr>
<tr>
<td>Ralph W. Atkinson</td>
<td>1952</td>
</tr>
<tr>
<td>John P. Baylor Memorial</td>
<td>1960</td>
</tr>
<tr>
<td>Julia Binns</td>
<td>1970</td>
</tr>
<tr>
<td>William Braddock Memorial</td>
<td>1945</td>
</tr>
</tbody>
</table>
FEDERALLY INSURED LOAN PROGRAM

The Federally Insured Loan Program enables students to borrow money through home-town lending institutions. Students accepted for enrollment, or enrolled as at least half-time students, are eligible to borrow. If the student qualifies for the Federal interest benefits, the Federal Government pays all the interest while the student remains in school. Upon graduation or withdrawal the student has an obligation to repay his loan at an interest rate of seven percent.

HEALTH PROFESSIONS STUDENT LOAN AND SCHOLARSHIP PROGRAMS

The Health Professions Student Loan Program was authorized by the Health Professions Education Assistance Act of 1963, as amended. The purpose of the program is to increase the opportunities for the training of physicians, dentists, veterinarians and other students who demonstrate financial need, while in the professional school.

Any student interested in these programs must submit a confidential financial statement.

OFFICER EDUCATION (ROTC)

Financial Assistance Grants

All students enrolled in Advanced ROTC (third and fourth years) in Army, Navy and Air Force are provided a financial assistance grant of $100 per month. Officer Education Scholarship recipients are entitled to this financial assistance for the duration of the scholarship.

All-University Scholarships

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

Alda Wilson Scholarship for seniors. Must earn major part of expenses and have high scholastic standing.

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

Scholarships Listed Under Two or More Colleges

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

Ralph W. Anderson Scholarship for a student enrolled in journalism and mass communication.

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

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

Louis Champlin Jr. Scholarship for a student enrolled in journalism and mass communication.

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

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

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

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

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

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

Agricultural Scholarships

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

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

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

C.E. Bundy Scholarship for a junior enrolled in agricultural education.

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

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

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

Chicago and North Western Railway 4-H Scholarship for a junior, senior or graduate student in agricultural business or forestry. 4-H background and essay necessary. Apply to State 4-H Office by August 15.

Chicago Farmers’ Club Scholarship for a senior.

Bernard Collins Memorial Scholarship for a junior in animal science.

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

Cooperative Education Scholarships for freshmen interested in cooperative management who are residents of Allamakee, Black Hawk, Buchanan, Cedar, Clinton, Clayton, Delaware, Dubuque, Fayette, Henry, Jackson, Johnson, Jones, Keokuk, Linn, Louisa, Muscatine, Scott, Washington, and Winneshiek counties.

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

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

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

Dekalb Agricultural Research, Inc. 4-H Scholarship for junior in agricultural business. 4-H background required. Apply to State 4-H Office by August 15.

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

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

Electric Cooperative Pioneer Scholarship for a freshman in agricultural journalism.
A.T. Erwin Scholarship for a junior or senior in horticulture. No application necessary.

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

Farm Journal Scholarship for a freshman in agricultural journalism.

Farmland Industries, Inc. Scholarships for juniors and seniors in the College of Agriculture whose parents belong to an agricultural cooperative.

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

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

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

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

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

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

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

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

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

E.S. Haber Scholarship for a horticulture or landscape architecture undergraduate majoring in nursery management or planning a career in the landscape nursery business. Sponsored by the Iowa Nurserymen's Association. No application necessary.

Heaberlin Agronomy Award Scholarship for seniors who have attended an Iowa high school and are majoring in agronomy.

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

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

Iowa Crop Improvement Association Scholarship for a junior or senior in agronomy. 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.

Iowa Society of Farm Manager's and Rural Appraisers Scholarship for a junior or senior in the College of Agriculture with an interest in professional farm management.

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

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

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

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

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

Edwin T. Meredith Foundation 4-H Scholarship for freshmen in agriculture. 4-H background required. Apply to State 4-H Office by August 15.

Milwaukee Road Railroad 4-H Scholarship for freshman in agriculture. 4-H background required. Apply to State 4-H Office by August 15.

Moorman Manufacturing Company Scholarships for freshmen and sophomores.

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

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

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

Rice Estate Advanced Curriculum Scholarships for juniors and seniors.

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

Bruce Russell Scholarship for a junior in agricultural business, agricultural education, agronomy, animal science, dairy science or farm operation who has an interest in professional farm management.

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.

Wehr Corporation 4-H Scholarship for junior in agriculture. 4-H background required. Apply to State 4-H Office by August 15.

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

Chuck Worcester Intern Scholarship for a junior
Engineering Scholarships

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

Alcoa Engineering Achievement Scholarship for an engineering senior.

Alcoa Engineering Scholarships for undergraduates in engineering.

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

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

Black and Veatch Scholarships for freshmen in civil engineering.

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

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

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

Wallace L. Casell Memorial Scholarship for an electrical engineering junior.

Ceramic Engineering Alumni Fund Scholarship for a ceramic engineering student.

Continental Oil Company Scholarship for an undergraduate in chemical engineering.

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

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

Dow Corning Scholarship for a chemical engineering student.

Electric Cooperative Pioneer Scholarship for an electrical engineering student interested in power transmission.

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

Robert W. Flanagan Environmental Engineering Award for a civil engineering junior or senior.

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

Murray Gautsch Scholarship for a student in ceramic engineering.

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

Goodyear Scholarship for a senior in chemical or mechanical engineering.

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

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

Walter Handy Memorial Scholarship for a junior or senior in civil engineering.

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

Burdette Higgins Awards Scholarship for a graduating senior in architecture.

Donald D. Kaser Memorial Scholarship for a sophomore student in any engineering department.

Karl Keffer Memorial Scholarship for an architecture student.

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

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

Kimball Scholarship for students enrolled in the College of Engineering.

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

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

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

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

James P. McKeen Memorial Scholarship for an industrial engineering student.

Frank S. McCutcheon III Memorial Scholarship for a junior in metallurgy or mechanical engineering.

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

Minnesota Mining and Manufacturing Company Scholarships for engineering undergraduates.

Missouri Valley Machinery Company Scholarships for engineering freshmen.

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

Carl E. Nelson Scholarship for a junior or senior in engineering.

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

Pennsylvania Glass Sand Corporation Scholarship for a senior in ceramic engineering.
Pioneer Lumber Company Scholarship for a civil engineering junior or senior.

Frank Ricker Memorial Scholarship for a junior or senior in any engineering department.

Adolph Shane Memorial Scholarship for an electrical engineering junior or senior.

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

Sandstrand Corporation Foundation Scholarship for a freshman in mechanical or agricultural engineering.

Russell Thompson Memorial Scholarship for an undergraduate sophomore.

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

Western Electric Fund Scholarship for an engineering undergraduate.

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

Home Economics Scholarships

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

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

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

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

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

Bishop Buffets, Inc. Scholarships for men in four-year institution management degree programs. Inquire at Institution Management Department, 11E MacKay Hall.

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

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

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

Danforth Leadership Training Scholarship for a home economics freshman.

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

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

Electric Cooperative Pioneer Scholarship for an undergraduate in home economics journalism.

Electrical Women's Round Table Organization Awards for sophomores, juniors or seniors.

Ercel S. Eppright Recognition Awards for outstanding upperclass students in food and nutrition. No application.

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

Vera Foreman Friley Scholarship for a home economics senior.

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

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

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

Norma R. Holen Scholarship for a student in home economics with preference for textiles and clothing. Inquire at Textiles and Clothing Department, 140 MacKay Hall.

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

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

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

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

Millie Kalsem Award for a student in food and nutrition.

Catherine MacKay Scholarship for a home economics freshman.

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

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

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

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

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

Pearl Swanson Fellowship for a Ph.D. candidate in any major field 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.

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

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

Florence Walls Scholarship for sophomores and juniors.

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

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

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

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

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

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

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

Veterinary Medicine Scholarships

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

Allen Products Scholarships for students in veterinary medicine with financial need.

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

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

Keomah Kennel Club Scholarship for a worthy veterinary medicine student with financial need with preference to residents of Keokuk, Mahaska and bordering counties of Iowa.

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

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

Merck Veterinary Manual Award given to a junior and a senior.
Charles Pfazer and Company Award for a junior in veterinary medicine. Applications are submitted to the Chairman of the Honors and Awards Committee.

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

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

Charles Steele Memorial Award for a veterinary medicine sophomore.

Upjohn Award for a senior who shows proficiency in large animal medicine.

Upjohn Award for a senior who shows proficiency in small animal medicine.

Walnut Grove Large Animal Nutrition Award for a fourth year veterinary student.

Iowa State University Veterinary Medical Alumni Association Scholarships

Henry Dale Bergman Award for a third year student in veterinary medicine.

George Judisch Scholarship Prize for the fourth year veterinary student with the highest scholastic average.

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

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

bicycling, handball, squash, cross-country, basketball free throws, ice hockey, basketball, table tennis, wrestling, bridge, chess, swimming, indoor track, skiing, ice skating, water polo, racketball, softball, badminton, tennis, golf, outdoor track, and tug-o-war.

Women compete in touch football, cross-country, softball, volleyball, tennis, golf, bowling, basketball, basketball free throws, squash, archery, table tennis, swimming, fencing, bridge, chess, pocket billiards, skiing, badminton, ice skating, racketball, indoor and outdoor track, and canoe camping.

Co-recreational activities are offered in touch football, bowling, archery, trap shooting, bicycling, cross-country, basketball free throws, basketball, table tennis, bridge, swimming, indoor and outdoor track, ice skating, volleyball, racketball, badminton, golf, tennis, and tug-o-war.

Sports Clubs

Students who desire more opportunities for sports participation than offered by the intramural program, may wish to join one of the twenty-two sports clubs on campus. These include badminton, canoe, cycle, fencing, flying, handball, hockey, judo, rifle and pistol, rodeo, rugby, sailing, scuba, skiing, skydiving, soccer, tae-kwon-do, trap and skeet, volleyball, water polo, water skiing, and weight-lifting clubs.

These clubs offer instruction and competition at the local and intercollegiate levels. Dues are set by the club members and all clubs receive financial subsidy from the Government of the Student Body to enable students to participate regardless of their financial situation.

Debate and Forensics

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

Fraternities and Sororities

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

The 36 social fraternities with chapters at Iowa State have approximately 2,400 men and house about 2,000 of these. The cost of living in a fraternity house varies from $280 to $360 per quarter, with an average of $335. This amount includes room, board, social dues, and other chapter expenses. Initiation fees range from $20 to $117.50 per member, with an average cost of $80. The higher fees generally include the cost of the fraternity pin. First-year men students may live in a fraternity house.

There are approximately 980 women in the 14 national social sororities. The average house bill for each member of these chapters ranges from $330 to $375 per quarter, with an average cost of approximately $345. This amount includes room, board, social and national dues, other chapter expenses, and in some cases, the building fund payment. Initiation fees vary from $24 to $95. The higher figure may include the cost of the active's pin or "badge," building fund payment, and lifetime membership.

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

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

**Honor and Professional Organizations**

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

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

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

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

Seven other activities honoraries recognize students in various special areas.

**Independent Student Association**

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

**Lectures**

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

**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. Over-
night guest rooms are occupied by campus visitors. A bookstore meets nearly every student need.

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

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

Music Activities

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

Two concert series bring professional performers of high caliber to the campus and the city of Ames. Choral groups, orchestras, opera, ballet, and solo artists are presented. In addition, a series of concerts and recitals is given each year by members of the music faculty.

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

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.

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

The Student Religious Council plans and coordinates programs which bring the various student groups in dialogue with each other as well as with nonwestern religious groups.

The YWCA and YMCA are located in Alumni Hall, near central campus. They design programs which bring students to active participation in campus and community life and challenge them to a deeper exploration of their value commitments.

Residence Halls Associations

Approximately 8,100 undergraduates live in the residence halls at Iowa State University. These residence halls are organized geographically into three autonomous student associations: The Towers Residence Association (TRA), the Richardson Court Association (RCA), and the Union Drive Association (UDA). The approximately 2,700 students in each of these coeducational associations elect a group of executive officers who are responsible for coordinating University events and activities with the association residence hall program. In addition, each association funds and maintains a social program, an intramural program, a camera club, a ham radio club, and numerous committees that supplement the total social-educational development of the individual residents. The three associations also jointly sponsor several projects such as the KPGY AM-FM radio station and Residence Hall Week.

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

Seminar '73

Seminar '73 ('74, '75, etc.) was established by interested faculty and staff as a means of conducting discussion on current issues. The various seminars meet once a week, and ISU students are allowed one hour of credit for attendance. Leaders include students, ISU professors, and community leaders. Recent topics include "Campaign '72," "Applications of Space Technology," "Pornography and Censorship," "Leadership Styles," and "Film as Literature."

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.
Theatre and Dramatics

The Iowa State University Theatre, Department of Speech, produces a season of six major presentations each year, two each quarter. The season's bill endeavors to offer a variety of theatrical fare, including a musical, a children's play, well-known dramatic literature and unusual and lesser-known plays. Practical experience in all phases of theatrical production is open to interested, registered students within the University. The season is partially subsidized by an allocation from the Government of the Student Body; therefore, all students paying activity fees may attend a performance upon presentation of their activity fee card plus a small validation charge.

The Theatre also presents a series of fifteen films, five each quarter, including unusual and classic American and foreign films.

Other Theatre sponsored programs include Speech 455, directing-class projects; Laboratory Theatre, student-produced plays; Players, student dramatic organization; I-Alum, a local theatre honorary; Theta Alpha Phi, a national dramatics honorary; and a Summer Theatre program which is currently the Showboat Players located in Clinton, Iowa.

Bachelor's Degree Requirements

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

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

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

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

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

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

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

English Proficiency Requirement

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

Library Study

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.
Curriculum Requirements

The curriculum requirements both in number of credit hours and specific courses are guidelines for the student and his adviser in planning an academic program. The curriculum is subject to change and because of these changes adjustments may need to be made.

Catalog in Effect

The catalog under which a student wishes to graduate may be determined with certain limitations by the student. Subject to these limitations a student may elect the catalog in effect at the time of his graduation or either of the two catalogs in effect immediately prior to the one in effect at the time of graduation. He must select a catalog in effect during his enrollment and meet the full requirements of this catalog except in instances where courses are no longer available or where there have been program changes. These adjustments are made by the student with the approval of the head of the department in which the student is majoring.

Student Regulations

Grading System

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

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

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

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

Satisfactory Academic Progress

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

Class Attendance

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

Student Conduct

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

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

Motor Vehicles and Bicycles

Students are permitted to own and operate motor vehicles—automobiles, motor scooters, and motorcycles. Motor vehicles, however, are in no way necessary for an Iowa State student, and the University believes students under 19 years of age will find it to their best interests not to operate an automobile in Ames. Those who operate a motor vehicle or bicycle must abide by the rather extensive traffic and parking regulations, necessary because of the congestion on campus. Fines are levied for infractions of these regulations.

Pass-Not Pass

A limited number of courses may be elected under the Pass-Not Pass system. For the regulations regarding this system, see The Chart, the student handbook.
Colleges and Curricula

The University is organized into seven colleges: College of Agriculture, College of Education, College of Engineering, College of Home Economics, College of Sciences and Humanities, College of Veterinary Medicine, and the Graduate College.

The main academic programs of each are here listed, 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.

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. 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 bachelor’s degree from Iowa State.

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

Off-Campus Credit Courses

Iowa State University recognizes a responsibility to extend its resources to those people of Iowa qualified for admission, who, for various reasons, cannot attend or participate in classes on the campus. Therefore, courses for academic credit are offered away from the Ames campus at places and times intended to help Iowans fulfill their professional and personal educational goals. Continuous learning is seen as essential to fullest development of an individual’s potential.

Through its area and county Extension staffs and other information channels, Iowa State University continually seeks to identify the kind of academic courses appropriate to the changing and priority needs of a dynamic society. For further information write: Extension Courses and Conferences, Curtiss Hall, Iowa State University.

College of Agriculture

Students enrolled in the College of Agriculture are provided a broad based education which includes course work in communications; biological, physical, and social sciences; humanities; and technical subject matter. Each of the 20 curricula in the College of Agriculture provides sufficient specialization for the graduate to become established in his or her chosen profession.

Upon graduation students find diversified career opportunities, because of the well balanced education they have received as an undergraduate in their chosen curriculum in the College of Agriculture.

Career opportunities for graduates include (1) agriculture production, (2) business and industry, (3) public agencies, (4) education, and (5) graduate studies.

A student has a variety of curricula from which to choose. Each curriculum is unique in its own way. Yet there are many courses common to all curricula. This is helpful to students in that they may transfer from one curriculum to another in the College of Agriculture during their first two years with little, if any, loss of credits. The major difference found among curricula is in the course work required
by the department to help the student become established in his or her chosen profession.

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. All entering students and parents are encouraged to participate in the summer orientation program where they will have the opportunity to meet and work with academic advisers in planning their first quarter's schedule of classes. The advisers also assist students in making personal adjustments to university life, and provide helpful information on vocational choices.

A special effort is made by the advisers in the College of Agriculture to adjust the students' schedule of course work in accordance with their interests and capabilities.

Students may use their free electives to broaden their education, or to strengthen their area of specialization. Electives may be used to meet the requirements for a double major. Those who wish to change their curriculum, or who decide to graduate with a double major, must be enrolled for the last three quarters in the curriculum or curricula in which they expect to graduate.

A student may wish to prepare for admission to a professional program such as law, medicine, or veterinary medicine while pursuing a program toward a Bachelor of Science degree in the College of Agriculture. This may be accomplished through several curricula; however, it is recommended that the student work closely with his academic adviser to insure progress in the right direction.

Some departments require or recommend that students declare one or more minors. Minors must be declared through the academic adviser prior to being classified as a senior. Students declaring minors must include at least 20 credits for one minor or at least 15 credits in each of two minors.

Each department prepares a curriculum guide which is available to students to assist them in charting their long-term programs and to specify the exact requirements for graduation. All curricula have a six-month agricultural experience requirement for graduation (Ag. 104). This may be farm experience in some curricula or special work experience related to the major. Students who enroll in ROTC may apply these credits toward elective requirements.

In addition to studies required in each curriculum for professional competence, the College of Agriculture provides opportunities for the students to pursue activities and courses which will add to their personal growth. Each department has a departmental club which conducts activities designed to assist the students with the development of social attitudes and communication skills.

With the exception of the winter quarter program and two-year certificate program in Farm Operation, all other curricula in the College of Agriculture lead to a Bachelor of Science degree. Each curriculum has specific degree requirements for graduation, which include the group requirements for the College of Agriculture listed as follows:

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### Group Requirements, College of Agriculture

<table>
<thead>
<tr>
<th>Group</th>
<th>Requirements</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>I.</td>
<td>English and speech</td>
<td>11</td>
</tr>
<tr>
<td>II.</td>
<td>Mathematical sciences&lt;br&gt;(Computer science, mathematics, statistics.)</td>
<td>8</td>
</tr>
<tr>
<td>III.</td>
<td>Physical sciences&lt;br&gt;(Biochemistry, biophysics, chemistry, geology, meteorology, and physics.)&lt;br&gt;Up to 5 credits in mathematics above the departmental mathematical requirement may be substituted for physical sciences.</td>
<td>16</td>
</tr>
<tr>
<td>IV.</td>
<td>Biological sciences&lt;br&gt;(Bacteriology, biochemistry, geology, geophysics, botany, genetics, zoology.)</td>
<td>10</td>
</tr>
<tr>
<td>V.</td>
<td>Social sciences&lt;br&gt;(Anthropology, economics, government, psychology, sociology.)</td>
<td>12</td>
</tr>
<tr>
<td>VI.</td>
<td>Humanities&lt;br&gt;(Art, foreign languages at the 200 level or above, history, literature, music, philosophy.)</td>
<td>6</td>
</tr>
</tbody>
</table>

Graduate study in agriculture is conducted through the Graduate College. Details are found in the Graduate College section of the catalog.

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### Curriculum in Agricultural Business

Administered by the Department of Economics. Students are required to select one minor from the following: economic analysis, farm management, marketing management, public policy, agricultural journalism.

<table>
<thead>
<tr>
<th>Degree Requirements</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>I. Communication—Engl 104, 105; 302 or 414; Sp 211; Lib 160</td>
<td>14-15</td>
</tr>
<tr>
<td>II. Mathematical sciences—Math 104 or 109; Stat 101 or 104</td>
<td>10</td>
</tr>
<tr>
<td>III. Physical sciences—Chem 141, 141L, 142, 142L, 231, 232A; elective (3 cr.)</td>
<td>16</td>
</tr>
<tr>
<td>IV. Biological sciences—Biol 101, elective (4 cr.); Gen 340 or 360</td>
<td>10</td>
</tr>
<tr>
<td>V. Social sciences (excluding agricultural economics)—Econ 241, 242, 301, 304; 405 or 409; Soc 130 or 134; Psych 101; Pol S 215</td>
<td>28-29</td>
</tr>
<tr>
<td>VI. Humanities</td>
<td>6</td>
</tr>
<tr>
<td>VII. Agricultural Economics—Econ 110, 192, 330, 335, 447</td>
<td>16</td>
</tr>
</tbody>
</table>
Preprofessional Studies

Agricultural business provides preparation for studies in law.

Curriculum in Agricultural Education

Students in agricultural education may pursue a general or specialized program to prepare for teaching vocational agriculture. Areas of specialization are agricultural economics, agricultural mechanization, agronomy, animal science, or horticulture.

Degree Requirements

<table>
<thead>
<tr>
<th>Category</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>I. Communications</td>
<td>Engl 104, 105; Lib 160; electives (6 cr.)</td>
</tr>
<tr>
<td>II. Mathematical sciences</td>
<td>mathematics, statistics or computer science</td>
</tr>
<tr>
<td>III. Physical sciences</td>
<td>Chem 141, 141L, 142, 142L; 231 or 334; electives (3 to 5 cr.)</td>
</tr>
<tr>
<td>IV. Biological sciences</td>
<td>Biol. 101; 102A or 102B; biology electives (4 cr.)</td>
</tr>
<tr>
<td>V. Social sciences</td>
<td>Psych 230, 333; Econ 242; history or government</td>
</tr>
<tr>
<td>VI. Humanities</td>
<td></td>
</tr>
<tr>
<td>VII. Physical education</td>
<td></td>
</tr>
<tr>
<td>VIII. Agricultural sciences</td>
<td>Agron 114, 114A and 114B; Agron 154; An S 114 or F Tch 114; An S 318, 319</td>
</tr>
</tbody>
</table>

Typical Program for the First Two Years

FRESHMAN YEAR

<table>
<thead>
<tr>
<th>Fall</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Orientation in Agricultural Business</td>
<td>Econ 110</td>
</tr>
<tr>
<td>Agricultural Business Operations</td>
<td>Econ 192</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Winter</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Principles of Crop Production</td>
<td>Agron 114</td>
</tr>
<tr>
<td>Principles of Biology</td>
<td>Biol 101</td>
</tr>
<tr>
<td>General Chemistry</td>
<td>Chem 141</td>
</tr>
<tr>
<td>General Chemistry Lab</td>
<td>Chem 141L</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Spring</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Animal Production</td>
<td>An S 114</td>
</tr>
<tr>
<td>Biology of Plants</td>
<td>Biol 102A</td>
</tr>
<tr>
<td>Language in Composition and Reading</td>
<td>Engl 104</td>
</tr>
<tr>
<td>Physical education</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SOPHOMORE YEAR</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fall</td>
<td>Principles of Economics</td>
</tr>
<tr>
<td></td>
<td>Environmental Biology</td>
</tr>
<tr>
<td></td>
<td>Fundamentals of Soil Science</td>
</tr>
<tr>
<td></td>
<td>American Government</td>
</tr>
<tr>
<td></td>
<td>General Psychology</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Winter</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Principles of Economics</td>
<td>Econ 242</td>
</tr>
<tr>
<td>Organic Chemistry</td>
<td>Chem 231</td>
</tr>
<tr>
<td>Organic Chemistry Lab</td>
<td>Chem 232A</td>
</tr>
<tr>
<td>Fundamentals of Speech</td>
<td>Sp 211</td>
</tr>
<tr>
<td>Principles of Statistics</td>
<td>Stat 101</td>
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<table>
<thead>
<tr>
<th>Spring</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Money and Banking</td>
<td>Econ 304</td>
</tr>
<tr>
<td>Farm Management and Organization</td>
<td>Econ 330</td>
</tr>
<tr>
<td>Principles of Accounting</td>
<td>I Ad 384</td>
</tr>
<tr>
<td>History of American Agriculture</td>
<td>Hist 375</td>
</tr>
</tbody>
</table>

TOTAL 192

Typical Program for the First Two Years

FRESHMAN YEAR

<table>
<thead>
<tr>
<th>Fall</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Language in Composition and Reading</td>
<td>Engl 104</td>
</tr>
<tr>
<td>Finite Mathematics</td>
<td>Math 104</td>
</tr>
<tr>
<td>Principles of Crop Production</td>
<td>Agron 114</td>
</tr>
<tr>
<td>Metal Construction and Maintenance</td>
<td>A E 234</td>
</tr>
<tr>
<td>Orientation in Agricultural Education</td>
<td>Ag Ed 110</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Winter</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Language in Composition and Reading</td>
<td>Engl 105</td>
</tr>
<tr>
<td>Animal Production</td>
<td>An S 114</td>
</tr>
<tr>
<td>Principles of Biology</td>
<td>Biol 101</td>
</tr>
<tr>
<td>Agricultural Construction Materials and Procedures</td>
<td>A E 235</td>
</tr>
<tr>
<td>Library Instruction</td>
<td>Lib 160</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Spring</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Foundations of American Education</td>
<td>Educ 204</td>
</tr>
<tr>
<td>Biology of Organisms</td>
<td>Biol 102A</td>
</tr>
<tr>
<td>Meat and Meat Processing</td>
<td>An S 170</td>
</tr>
<tr>
<td>Principles of Horticulture</td>
<td>Hort 114</td>
</tr>
<tr>
<td>Publicity and Public Relations</td>
<td>Jl 225</td>
</tr>
<tr>
<td>Physical education</td>
<td></td>
</tr>
</tbody>
</table>

TOTAL 192
**Curriculum in Agricultural Journalism**

Administered by the Department of Journalism and Mass Communication.

**Degree Requirements**

<table>
<thead>
<tr>
<th>Fall</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>General Chemistry—Chem 141, 141L</td>
<td>4</td>
</tr>
<tr>
<td>Weed Identification and Control—Bot 216</td>
<td>4</td>
</tr>
<tr>
<td>Observation and Survey of Program of Education</td>
<td>2</td>
</tr>
<tr>
<td>Principles of Economics—Econ 242</td>
<td>3</td>
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<tr>
<td>Elective</td>
<td>3</td>
</tr>
<tr>
<td>Physical education</td>
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</table>

**Winter**

<table>
<thead>
<tr>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>General Chemistry—Chem 142, 142L</td>
</tr>
<tr>
<td>Developmental Psychology—Psych 230</td>
</tr>
<tr>
<td>Grain and Forage Crops—Agron 212</td>
</tr>
<tr>
<td>Farm Accounting and Business Analysis—Econ 230</td>
</tr>
<tr>
<td>Fundamentals of Speech—Sp 211</td>
</tr>
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</table>

**Spring**

<table>
<thead>
<tr>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elementary Organic Chemistry—Chem 231 or</td>
</tr>
<tr>
<td>Organic Chemistry—Chem 334</td>
</tr>
<tr>
<td>Educational Psychology—Psych 338</td>
</tr>
<tr>
<td>Fundamentals of Soil Science—Agron 154</td>
</tr>
<tr>
<td>Agricultural Marketing—Econ 335</td>
</tr>
<tr>
<td>Elective</td>
</tr>
<tr>
<td>Physical education</td>
</tr>
</tbody>
</table>

*For certification in an area of agricultural specialization, a total of 72 agriculture credits is required with at least 36 credits in one area and 20 credits in a second area.

**Typical Program for the First Two Years**

**FRESHMAN YEAR**

<table>
<thead>
<tr>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Language in Composition and Reading—Engl 104</td>
</tr>
<tr>
<td>Finite Mathematics—Math 104</td>
</tr>
<tr>
<td>Principles of Biology—Biol 101</td>
</tr>
<tr>
<td>Experimental Biology—Biol 101A</td>
</tr>
<tr>
<td>Library Instruction—Lib 160</td>
</tr>
<tr>
<td>Physical education</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Language in Composition and Reading—Engl 106</td>
</tr>
<tr>
<td>Principles of Statistics—Stat 101 (6 cr.)</td>
</tr>
<tr>
<td>General Chemistry—Chem 141, 141L</td>
</tr>
<tr>
<td>Principles of Crop Production—Agron 114</td>
</tr>
<tr>
<td>Physical education</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fundamentals of Speech—Sp 211</td>
</tr>
<tr>
<td>Introduction to Mass Communication—Jl 101</td>
</tr>
<tr>
<td>General Chemistry—Chem 142, 142L</td>
</tr>
<tr>
<td>Fundamentals of Soil Science—Agron 154</td>
</tr>
<tr>
<td>General Psychology—Psych 101</td>
</tr>
<tr>
<td>Physical education</td>
</tr>
</tbody>
</table>

**SOPHOMORE YEAR**

<table>
<thead>
<tr>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Animal Production—An S 114</td>
</tr>
<tr>
<td>Biology of Organisms—Biol 102A</td>
</tr>
<tr>
<td>Basic Reporting—Jl 201</td>
</tr>
<tr>
<td>Introduction to Sociology—Soc 134</td>
</tr>
<tr>
<td>Free elective or group elective</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Feeds and Feeding—An S 218*</td>
</tr>
<tr>
<td>Environmental Biology—Biol 103</td>
</tr>
<tr>
<td>Principles of Economics—Econ 241</td>
</tr>
<tr>
<td>Basic Reporting—Jl 202</td>
</tr>
<tr>
<td>Free elective or group elective</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>American Government—Pol S 215</td>
</tr>
<tr>
<td>Principles of Economics—Econ 242</td>
</tr>
<tr>
<td>History of American Agriculture—Hist 375</td>
</tr>
<tr>
<td>Basic Reporting—Jl 203</td>
</tr>
<tr>
<td>Free elective or group elective</td>
</tr>
</tbody>
</table>

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

Administered by the Department of Agricultural Engineering.

Degree Requirements

<table>
<thead>
<tr>
<th>Credits</th>
<th>Fall</th>
</tr>
</thead>
<tbody>
<tr>
<td>15</td>
<td>Communications—Engl 104, 105; Sp 221; JI 225; Lib 160</td>
</tr>
<tr>
<td>11 or 13</td>
<td>Mathematical sciences—Math 104 and 161, or 120 and 121; Com S 201</td>
</tr>
<tr>
<td>20</td>
<td>Physical sciences—Chem 141, 141L, 142, 142L, 231, 232C; Phys 111, 112</td>
</tr>
<tr>
<td>10</td>
<td>Biological sciences—Biol 101, 102A, 102B, 103</td>
</tr>
<tr>
<td>12</td>
<td>Social sciences—Econ 241, 242; Pol S 215; electives</td>
</tr>
<tr>
<td>6</td>
<td>Humanities</td>
</tr>
<tr>
<td>33</td>
<td>Agricultural sciences—Ag M 110, 190, 254, 255, 306, 394, 344, 345, 364, 366, 401, 419; electives</td>
</tr>
<tr>
<td>43</td>
<td>Other required courses—E Gr 161; I Ad 340, 365C or Econ 451; I Ad 384, 443, 488</td>
</tr>
<tr>
<td>19</td>
<td>X. Physical education</td>
</tr>
<tr>
<td>3</td>
<td>XI. Free electives</td>
</tr>
<tr>
<td>18 or 20</td>
<td>TOTAL</td>
</tr>
</tbody>
</table>

TOTAL 192

Typical Program for the First Two Years

FRESHMAN YEAR

Fall

- Language in Composition and Reading—Engl 104
- Principles of Crop Production—Agron 114
- General Chemistry—Chem 141, 141L
- Principles of Mechanization in Agriculture—Ag M 190
- Orientation—Ag M 110
- Physical education

Winter

- Language in Composition and Reading—Engl 105
- General Chemistry—Chem 142, 142L
- Principles of Biology—Biol 101
- Biology of Organisms—Biol 102A
- Metal Construction and Maintenance—Ag M 254
- Physical education

Spring

- Animal Production—An S 114
- Environmental Biology—Biol 103
- Biology of Organisms—Biol 102B
- Agricultural Construction Materials and Procedures—Ag M 255
- Library Instruction—Lib 160
- Physical education

SOPHOMORE YEAR

Fall

- Elementary Organic Chemistry—Chem 231, 232C
- Finite Mathematics—Math 104
- Analytical Geometry and Calculus—Math 120
- Fundamentals of Soil Science—Agron 164
- Small Power Equipment—Ag M 344

Winter

- General Physics—Phys 111
- Intuitive Calculus—Math 161 (3 cr.) and Elective (2 cr.)
- Analytical Geometry and Calculus—Math 121 (5 cr.)
- Principles of Economics—Econ 244
- Farm Machinery and Power Management—Ag M 334

Spring

- General Physics—Phys 112
- Foundations of Engineering Graphics—E Gr 161
- Principles of Economics—Econ 244
- Soil and Water Management—Ag M 306
- Publicity and Public Relations—JI 225

Curriculum in Agronomy

Students majoring in agronomy are required to specialize in crop science, soil science or agricultural climatology.

Degree Requirements

<table>
<thead>
<tr>
<th>Credits</th>
<th>Fall</th>
</tr>
</thead>
<tbody>
<tr>
<td>18</td>
<td>Communications—Engl 104, 105; Sp 221; Lib 160; electives (6 cr.)</td>
</tr>
<tr>
<td>9-10</td>
<td>Mathematical sciences—Math 104 or 105 or 109 or 120; Stat 101 or 104</td>
</tr>
<tr>
<td>15-18</td>
<td>Physical sciences—Chem 141, 141L, 142, 142L; or 147, 147L, 148, 148L; 231 and 232, or 334; Phys 101 or 106 or 111 or 221</td>
</tr>
<tr>
<td>39</td>
<td>Biological sciences—Biol 101, 101A, 102B; Bot 107; 310 or 320; Gen 340; Bact 300; B &amp; B 301 or An S 318</td>
</tr>
<tr>
<td>39</td>
<td>V. Social sciences—Soc 134 or Psych 101; Econ 241; Pol S 215; electives (3 cr.)</td>
</tr>
<tr>
<td>6-10</td>
<td>VI. Humanities—electives (6 cr.)</td>
</tr>
<tr>
<td>36</td>
<td>VII. Agronomic science—Agron 110, 114, 154, 206, 310, 318, 354, 411, 451; electives (18 cr.)</td>
</tr>
<tr>
<td>3</td>
<td>VIII. Physical education</td>
</tr>
<tr>
<td>57-64</td>
<td>IX. Electives</td>
</tr>
</tbody>
</table>

TOTAL 192

Typical Program for the First Two Years

FRESHMAN YEAR

Fall

- Orientation in Agronomy—Agron 110
- Principles of Crop Production—Agron 114
- Principles of Biology—Biol 101
- General Chemistry—Chem 141, 141L; or 147, 147L
- Language in Composition and Reading—Engl 104
- Physical education
Curriculum in Animal Ecology

Administered by the Department of Zoology and Entomology.

Degree Requirements

I. Communications—Engl 104, 105; Sp 211; Jl 225 or Engl 414; Lib 160 .......... 15
II. Mathematical sciences—Math 104 or 109; 161, 162; Stat 101; Com S 201 .......... 19
III. Physical sciences—Chem 141, 141L, 142, 142L, 310, 393, 396; B & B 301; Physics 111, 112; Geol 100 .......... 32
V. Social sciences—Econ 242, electives (9 cr.) .......... 12
VI. Humanities .......... 9
VII. Physical education .......... 3
VIII. Free electives .......... 36

TOTAL 192

Typical Program for the First Two Years

FRESHMAN YEAR

Fall 
Principles of Biology—Biol 101 .......... 3
General Chemistry—Chem 141, 141L .......... 4
Language in Composition and Reading—Engl 104 .......... 4
Principles of Economics—Econ 242 .......... 3
Technical Lecture—Zool 100 .......... 1
Physical education .......... 1

Winter 
Environmental Biology—Biol 103 .......... 3
General Zoology—Zool 106 .......... 5
Principles of Statistics—Stat 101 .......... 5
Physical education .......... 1
Electives .......... 3

SOPHOMORE YEAR

Fall 
Introduction to Geology—Geol 100 .......... 4
Computer Programming—Com S 201 .......... 3
Library Instruction—Lib 160 .......... 1
General Physics—Phys 111 .......... 4

Winter 
General Botany—Bot 107 .......... 6
General Physics—Phys 112 .......... 4
Vertebrate Biology—Zool 200 .......... 5
Intuitive Calculus—Math 161 .......... 3

Spring 
Plant Taxonomy—Bot 306 .......... 4
General Entomology—Zool 370 .......... 3
Intuitive Calculus—Math 162 .......... 3

Animal Ecology majors wishing to specialize in Water Pollution Biology should also take Chem 211; F Tch 414; C E 304, 325, 428; Zool 464.

Curriculum in Animal Science

Degree Requirements

I. Communications—Engl 104, 105; electives (12 cr.); Lib 160 .......... 21
II. Mathematical sciences—Stat 101; mathematics (5 cr.) .......... 10
III. Physical sciences—Chem 141, 141L, 142, 142L; organic chemistry (3 cr.); electives (5 cr.) .......... 16
IV. Biological sciences—Biol 101, 101A, 300; Gen 340; V An 217; V Phy 264 .......... 19
V. Social Sciences—Econ 241, 242; electives (12 cr.) .......... 18
VI. Humanities .......... 6
VII. Animal science—An S 110, 114, 170, 318, 319, 350, 351; 15 credits at the 400-level .............................................................. 37
VIII. Agricultural sciences—Ag 104;
Agron 114, 154............................................ 8
IX. Physical education ........................................ 3
X. Free electives ........................................... 54

TOTAL 192

Typical Program for the First Two Years

FRESHMAN YEAR

Fall Credits
Orientation in Animal Science—An S 110 ................................ R
Animal Production—An S 114 .................................... 5
Principles of Biology—Biol 101, 101A .......................... 5
Library Instruction—Lib 160 ..................................... 1
Mathematics ....................................................... 5
Physical education .............................................. 1

Winter Credits
Language in Composition and Reading—Engl 104 ........ 4
General Chemistry—Chem 141, 141L .......................... 4
Principles of Statistics—Stat 101 .............................. 5
Elective .................................................................. 3
Physical education .............................................. 1

SOPHOMORE YEAR

Fall Credits
Anatomy of Domestic Animals—V An 217 ..................... 3
Fundamentals of Soil Science—Agron 154 ..................... 4
Electives ................................................................ 9

Winter Credits
Physiology of Domestic Animals—V Phy 264 ............... 3
Organic Chemistry ............................................. 3
Principles of Economics—Econ 241 ............................ 3
Electives ................................................................ 6

Spring Credits
Principles of Economics—Econ 242 ............................. 3
Electives ................................................................ 12

Preprofessional Studies

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

Curriculum in Biometry

Administered by the Department of Statistics.

The major in biometry will take courses in statistics and mathematics, and, with the guidance of an advisory committee from agriculture, will select technical agriculture courses which will provide some depth of training in an agriculturally related area.

Degree Requirements

Credits

I. Communications—Engl 104, 105; Sp 211; Lib 160 ............................................................... 12
II. Mathematical sciences—Math 120,
121, 122, 223; Com S 201 ........................................ 23
III. Physical sciences—Chem 141, 141L,
142, 142L, 231; Phys 111 ........................................ 15
IV. Biological sciences—Biol 101, 101A,
elective; Gen 301 .................................................. 11
V. Social sciences—Econ 241, 242; Pol S
215; Soc 134 ....................................................... 12
VI. Humanities ................................................... 6
VII. Agricultural sciences—Agron 114A, 154A;
An S 114; Ag 104 ................................................. 13
VIII. Technical agriculture—selected from
agronomy, animal science, biology,
entomology, fisheries and wildlife
biology, food technology, forestry, or
plant pathology as arranged by
advisory committee ............................................. 32
IX. Statistics—Stat 100, 104, 341, 342, 343,
360, 401, 402, 411, 421, 482, electives .......... 38
X. Physical education ........................................... 3
X1. Electives .......................................................... 27

TOTAL 192

Typical Program for the First Two Years

FRESHMAN YEAR

Fall Credits
Principles of Crop Production—Agron 114 ..................... 4
General Chemistry—Chem 141, 141L .......................... 4
Language in Composition and Reading—Engl 104 ........ 4
Introduction to Sociology—Soc 134 .......................... 3
Physical education .............................................. 1

Winter Credits
Animal Production—An S 114 .................................. 5
General Chemistry—Chem 142, 142L ........................ 4
Introduction to Statistics—Stat 104 .......................... 5
Physical education .............................................. 1
Library Instruction—Lib 160 .................................... 1

Spring Credits
Experimental Biology—Biol 101, 101A ....................... 5
Analytic Geometry and Calculus—Math 120 ............. 5
Language in Composition and Reading—Engl 106 ........ 4
Computer Programming—Com S 201 ....................... 3

SOPHOMORE YEAR

Fall Credits
Principles of Economics—Econ 241 ............................ 3
Analytic Geometry and Calculus—Math 121 ............... 5
General Physics—Phys 111 ..................................... 4
American Government—Pol S 215 ......................... 3
Physical education .............................................. 1
**Curriculum in Dairy Science**

Administered by the Department of Animal Science.

**Degree Requirements**

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>I. Communications—Engl 104, 105; Sp 211; electives (8 cr.): Lib 160</td>
<td>20</td>
</tr>
<tr>
<td>II. Mathematical sciences—Stat 101; mathematics (5 cr.)</td>
<td>10</td>
</tr>
<tr>
<td>III. Physical sciences—Chem 141, 141L, 142, 142L; organic chemistry (3 cr.); electives (5 cr.)</td>
<td>16</td>
</tr>
<tr>
<td>IV. Biological sciences—Biol 101, 101A; Biol 300; Gen 340; V An 217; V Phy 264</td>
<td>19</td>
</tr>
<tr>
<td>V. Social sciences—Econ 241, 242; electives (6 cr.)</td>
<td>12</td>
</tr>
<tr>
<td>VI. Humanities</td>
<td>6</td>
</tr>
<tr>
<td>VII. Professional dairy science courses An S 110, 114, 170, 271, 318, 319, 350, 351, 434, 436, 437; F Tch 114</td>
<td>38</td>
</tr>
<tr>
<td>VIII. Agricultural sciences—Ag 104; Agron 114, 154</td>
<td>8</td>
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<tr>
<td>IX. Physical education</td>
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</tr>
<tr>
<td>X. Free electives</td>
<td>60</td>
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<tr>
<td><strong>TOTAL</strong></td>
<td><strong>192</strong></td>
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</table>

**Typical Program for the First Two Years**

**FRESHMAN YEAR**

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>Fall Orientation in Dairy Science—An S 110</td>
<td>R</td>
</tr>
<tr>
<td>Animal Production—An S 114</td>
<td>5</td>
</tr>
<tr>
<td>Language in Composition and Reading—Engl 104</td>
<td>4</td>
</tr>
<tr>
<td>Principles of Biology—Biol 101, 101A</td>
<td>5</td>
</tr>
<tr>
<td>Library instruction—Lib 160</td>
<td>1</td>
</tr>
<tr>
<td>Physical education</td>
<td>1</td>
</tr>
<tr>
<td>Winter Introduction to Food Technology—F Tch 114</td>
<td>4</td>
</tr>
<tr>
<td>Language in Composition and Reading—Engl 105</td>
<td>4</td>
</tr>
<tr>
<td>General Chemistry—Chem 141, 141L</td>
<td>4</td>
</tr>
<tr>
<td>Meat and Meat Processing—An S 170</td>
<td>S</td>
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<tr>
<td>Physical education</td>
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</tr>
<tr>
<td><strong>TOTAL</strong></td>
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**SPRING**

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
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<tbody>
<tr>
<td>Principles of Economics—Econ 242</td>
<td>3</td>
</tr>
<tr>
<td>Analytic Geometry and Calculus—Math 122</td>
<td>6</td>
</tr>
<tr>
<td>Fundamentals of Speech—Sp 211</td>
<td>3</td>
</tr>
<tr>
<td>Statistical Methods—Stat 401</td>
<td>4</td>
</tr>
<tr>
<td>Technical agriculture</td>
<td>3</td>
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</table>

**SOPHOMORE YEAR**

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fall Principles of Statistics—Stat 101</td>
<td>5</td>
</tr>
<tr>
<td>Anatomy of Domestic Animals—V An 217</td>
<td>3</td>
</tr>
<tr>
<td>Organic Chemistry</td>
<td>3 or 5</td>
</tr>
<tr>
<td>Animal science elective</td>
<td>3</td>
</tr>
<tr>
<td>Social science elective</td>
<td>3</td>
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<tr>
<td>Winter Principles of Economics—Econ 241</td>
<td>3</td>
</tr>
<tr>
<td>Physiology of Domestic Animals—V Phy 264</td>
<td>3</td>
</tr>
<tr>
<td>Fundamentals of Soil Science—V Agron 154</td>
<td>3</td>
</tr>
<tr>
<td>Humanities elective</td>
<td>3</td>
</tr>
<tr>
<td>Communications elective</td>
<td>3</td>
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<tr>
<td>Spring Introductory Genetics—Gen 340</td>
<td>3</td>
</tr>
<tr>
<td>Meat Animal Evaluation—An S 271</td>
<td>3</td>
</tr>
<tr>
<td>Electives</td>
<td>9</td>
</tr>
</tbody>
</table>

**Preprofessional Studies**

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

**Curriculum in Entomology**

Administered by the Department of Zoology and Entomology.

**Degree Requirements**

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>I. Communications—Engl 104, 105; Sp 211; Lib 160</td>
<td>12</td>
</tr>
<tr>
<td>II. Mathematical sciences—Math 104 or 109; Stat 101; Com S 201</td>
<td>13</td>
</tr>
<tr>
<td>III. Physical sciences—Chem 141, 141L, 142, 142L, 334, 335, 337; Phys 111, 112; Geol 100</td>
<td>28</td>
</tr>
<tr>
<td>IV. Biological sciences—Biol 101, 101A; Biol 300; Bot 107, 306, 310; Gen 350; Zool 106, 307, 320, 334</td>
<td>49</td>
</tr>
<tr>
<td>V. Social sciences—Econ 241, 242; Soc 134; Pol S 215</td>
<td>15</td>
</tr>
<tr>
<td>VI. Humanities—Engl 201, 414; electives</td>
<td>18</td>
</tr>
<tr>
<td>VII. Agricultural sciences—Agron 114, 154; Hort 114A</td>
<td>11</td>
</tr>
<tr>
<td>VIII. Entomology—Zool 100, 370, electives</td>
<td>16</td>
</tr>
<tr>
<td>IX. Physical education</td>
<td>3</td>
</tr>
<tr>
<td>X. Free electives</td>
<td>27</td>
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<tr>
<td><strong>TOTAL</strong></td>
<td><strong>192</strong></td>
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</tbody>
</table>
Typical Program for the First Two Years

FRESHMAN YEAR

Fall
Principles of Biology—Biol 101 ............................................... 3
Experimental Biology—Biol 101A .............................................. 3
General Chemistry—Chem 141, 141L ....................................... 4
Finite Mathematics—Math 104 (5 cr.) ...................................... 4
or
Precalculus Mathematics—Math 109 (5 cr.) ........................... 5
Technical Lecture—Zool 100 ................................................ 1
Physical education ............................................................. 1

Winter
Environmental Biology—Biol 103 ........................................... 3
General Chemistry—Chem 142, 142L ....................................... 4
Principles of Statistics—Stat 101 ........................................... 5
Language in Composition and Reading—Engl 104 .................... 4
Physical education ............................................................. 1

Spring
General Zoology—Zool 106 .................................................. 5
General Botany—Bot 107 ..................................................... 5
Language in Composition and Reading—Engl 105 .................... 4
Library Instruction—Lib 160 ................................................ 1
Physical education ............................................................. 1

SOPHOMORE YEAR

Fall
General Entomology—Zool 370 ............................................. 4
Organic Chemistry—Chem 334 ............................................. 4
Computer Programming—Comp S 201 ................................. 3
Principles of Crop Production—Agron 114 .............................. 4
Introduction to Literature—Engl 201 ..................................... 3

Winter
Comparative Anatomy—Zool 320 ........................................... 5
Organic Chemistry—Chem 335 ............................................. 3
Introduction to Geology—Geol 100 ........................................ 4
Principles of Economics—Econ 241 ....................................... 3

Spring
Plant Taxonomy—Bot 308 .................................................. 4
Laboratory in Organic Chemistry—Chem 337 .......................... 2
Fundamentals of Soil Science—Agron 154 ............................ 4
Principles of Economics—Econ 242 ....................................... 4
Introduction to Sociology—Soc 134 ....................................... 4

III. Physical sciences—Chem 141, 141L, 142, 142L; organic chemistry (3-5 cr.); electives (3-5 cr.) ........................................ 16
IV. Biological sciences—Biol 101, 109; electives (6 cr.) .......... 10
V. Social sciences—Econ 241, 242; electives (6 cr.) ............ 12
VI. Humanities ................................................................. 6
VII. Agricultural sciences—Ag.M. electives (9 cr.); Agron 114, 154, 212; An S 114, 318; electives (3 cr.); Econ 330; 430 or 451 or Ag 450; electives (3 cr.); 20 credits 300-level or above to be chosen from agricultural mechanization, agronomy, animal science, and agricultural economics ................................................... 63 or 64
VIII. Other required courses—Ag 110, 499 ......................... 1
IX. Physical education .......................................................... 3
X. Free electives ............................................................... 54 to 56

TOTAL 192

Typical Program for the First Two Years

FRESHMAN YEAR

Fall
Animal Production—An S 114 ............................................... 5
Principles of Biology—Biol 101 ........................................... 3
Language in Composition and Reading—Engl 104 .................... 4
Library Instruction—Lib 160 ................................................ 1
Farm Operation Orientation—Ag 110 ..................................... 1

Winter
Principles of Crop Production—Agron 114 .............................. 4
Language in Composition and Reading—Engl 105 .................... 4
Biological sciences elective ............................................. 4
Physical education ............................................................. 1
Elective ............................................................................. 3

Spring
Grain and Forage Crops—Agron 212 ..................................... 4
Environmental Biology—Biol 103 ........................................... 3
Mathematics and/or statistics ............................................. 5
Physical education ............................................................. 1
Agricultural mechanization elective ................................... 3

SOPHOMORE YEAR

Fall
General Chemistry—Chem 141, 141L ..................................... 4
Principles of Economics—Econ 241 ..................................... 3
Agricultural economics elective .......................................... 3
Animal science elective .................................................... 3
Elective ............................................................................. 3

Winter
Fundamentals of Speech—Sp 211 ......................................... 3
General Chemistry—Chem 142, 142L ..................................... 4
Principles of Economics—Econ 242 ..................................... 3
Fundamentals of Soil Science—Agron 154 ............................ 4
Elective ............................................................................. 3

Spring
Farm Management and Organization—Econ 330 ..................... 4
Organic chemistry ............................................................. 3-5
Social sciences elective .................................................... 3
Agricultural mechanization elective ................................... 3
Mathematics and/or statistics ............................................. 3

Curriculum in Farm Operation

Administered by the College of Agriculture. It includes a collegiate winter quarter program, a two-year program leading to a certificate in technical agriculture, and a four-year degree program.

Degree Requirements

I. Communications—Engl 104, 105; Sp 211;
   Lib 160; electives (5-6 cr.) ......................................... 17 or 18
II. Mathematical sciences ............................................... 8
Two-year Certificate*

Certificate Requirements

1. Communications—Engl 104, 105; Sp 211; Jl 225 or Engl 414; Lib 160 ....... 12
2. Physical sciences—Chem 141, 141L; or 141, 141L ........ 4
3. Biological sciences—Biol 101, 103 ........ 6
4. Social sciences—Soc 130 ........ 4
5. Agricultural sciences—Ag M 134, 136, 164, 219, 254, 255; Agron 114, 154, 212, 244; An S 114, 218; electives (3 cr.); Econ 130; electives (3 cr.) ........ 50
6. Other required courses—Ag 110 ........ R
7. Physical education.................. 3
8. Free electives........................ 17

TOTAL 96

* A 1.75 grade point is required

Winter Quarter Program

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>Farm Operation Orientation—Ag 110</td>
<td>R</td>
</tr>
<tr>
<td>Farm Machinery Management—Ag M 134</td>
<td>2</td>
</tr>
<tr>
<td>Agricultural Maintenance Welding—Ag M 154</td>
<td>2</td>
</tr>
<tr>
<td>Crop Production—Agron 112</td>
<td>3</td>
</tr>
<tr>
<td>Soils—Agron 152</td>
<td>3</td>
</tr>
<tr>
<td>Animal Production—An S 114</td>
<td>5</td>
</tr>
<tr>
<td>Elements of Farm Management—Econ 130</td>
<td>4</td>
</tr>
</tbody>
</table>

TOTAL 19

Curriculum in Fisheries and Wildlife Biology

Administered by the Department of Zoology and Entomology.

Degree Requirements

1. Communications—Engl 104, 105; Sp 211; Jl 225 or Engl 414; Lib 160 ....... 15
2. Mathematical sciences—Math 104 or 109; Math 120 or Stat 101; Com S 201 .... 13
3. Physical sciences—Chem 141, 141L, 142, 142L, 231, 232; Phys 111, 112; Geol 100 .... 25
5. Social sciences—Econ 242; electives (9 cr.) .... 12
6. Humanities ................................ 9
7. Other required courses—Ag M 306; Agron 154; forestry or outdoor recreation elective .......... 9
8. Credits ................................... 192

VIII. Physical education ................ 3
IX. Free electives ......................... 17

TOTAL 192

Typical Program for the First Two Years

FRESHMAN YEAR

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fall Principal of Biology—Biol 101</td>
<td>3</td>
</tr>
<tr>
<td>General Chemistry—Chem 141, 141L</td>
<td>4</td>
</tr>
<tr>
<td>Language in Composition and Reading—Engl 104</td>
<td>3</td>
</tr>
<tr>
<td>Principles of Economics—Econ 242</td>
<td>3</td>
</tr>
<tr>
<td>Technical Lecture—Zool 100</td>
<td>R</td>
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<tr>
<td>Physical education</td>
<td>1</td>
</tr>
<tr>
<td>Winter</td>
<td>Credits</td>
</tr>
<tr>
<td>Environmental Biology—Biol 103</td>
<td>3</td>
</tr>
<tr>
<td>General Zoology—Zool 106</td>
<td>5</td>
</tr>
<tr>
<td>Principles of Statistics—Stat 101 or</td>
<td>5</td>
</tr>
<tr>
<td>Analytical Geometry and Calculus 1—Math 120</td>
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</tr>
<tr>
<td>Physical education</td>
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</tbody>
</table>

SOPHOMORE YEAR

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fall Introduction to Geology—Geol 100</td>
<td>4</td>
</tr>
<tr>
<td>Computer Programming—Com S 201</td>
<td>3</td>
</tr>
<tr>
<td>Library Instruction—Lib 160</td>
<td>1</td>
</tr>
<tr>
<td>General Physics—Phys 111</td>
<td>4</td>
</tr>
<tr>
<td>Comparative Anatomy—Zool 320</td>
<td>5</td>
</tr>
<tr>
<td>Winter</td>
<td>Credits</td>
</tr>
<tr>
<td>General Botany—Bot 107</td>
<td>5</td>
</tr>
<tr>
<td>General Physics—Phys 112</td>
<td>4</td>
</tr>
<tr>
<td>Vertebrate Biology—Zool 200</td>
<td>5</td>
</tr>
<tr>
<td>Spring</td>
<td>Credits</td>
</tr>
<tr>
<td>Fundamentals of Soil Science—Agron 154</td>
<td>4</td>
</tr>
<tr>
<td>Plant Taxonomy—Bot 306</td>
<td>4</td>
</tr>
<tr>
<td>Ornithology—Zool 340</td>
<td>4</td>
</tr>
<tr>
<td>General Entomology—Zool 370</td>
<td>4</td>
</tr>
</tbody>
</table>

Curriculum in Food Technology

Students majoring in food technology must declare a science or business minor.

Degree Requirements

1. Communications—Engl 104, 105; Sp 211; Lib 160 .......... 12
3. Physical sciences—Chem 141, 141L, 142, 142L; or 147, 147L, 148, 148L ........ 8
curriculum in forestry

Students majoring in forestry are required to select an area of specialization in Forest Resource Management (accredited by Society of American Foresters) or Forest Products.

Degree Requirements

<table>
<thead>
<tr>
<th>Area</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>I. Communications—Lib 160; Engl 104, 105, 414, Sp 211</td>
<td>15</td>
</tr>
<tr>
<td>II. Mathematical sciences—Math 109, 161, 162, Stat 104; Com S 201</td>
<td>20</td>
</tr>
<tr>
<td>III. Physical sciences—Chem 141, 141L, 142, 142L, 231, 232A or 334; Phys 111</td>
<td>15-17</td>
</tr>
<tr>
<td>IV. Biological sciences—Biol 101, 101A, 107</td>
<td>11</td>
</tr>
<tr>
<td>V. Social science—Econ 241, 242; Pol S 215; electives</td>
<td>15</td>
</tr>
<tr>
<td>VI. Humanities</td>
<td>9</td>
</tr>
<tr>
<td>VII. Forestry courses—For 101, 201, 202, 203, 204, 380, 241, 301, 397, 451, 452, 453, 454</td>
<td>40</td>
</tr>
</tbody>
</table>

Areas of specialization—

A. Forest Resource Management—Bot 256, 310, 416; C E 210; Agron 357; For 302, 442, 445; additional renewable natural resources; electives (6 cr.), select from For 360, 390, 407, 460, 491; Zool 241, 461; L A 404; Electives | 15-17 |

B. Forest Products—For 386, 481, 485, 487, 488, 489; Bot 417; Electives | 23 |

IX. Physical education | 3 |

TOTAL 201

Typical Program for the First Two Years

FRESHMAN YEAR

<table>
<thead>
<tr>
<th>Fall</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Language in Composition and Reading—Engl 104</td>
<td>4</td>
</tr>
<tr>
<td>Precalculus Mathematics—Math 109</td>
<td>5</td>
</tr>
<tr>
<td>General Chemistry—Chem 141, 141L or 147, 147L</td>
<td>4</td>
</tr>
<tr>
<td>Library Instruction—Lib 160</td>
<td>1</td>
</tr>
<tr>
<td>Orientation—For 110</td>
<td>1</td>
</tr>
<tr>
<td>Physical education</td>
<td>1</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Winter</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Language in Composition and Reading—Engl 105</td>
<td>4</td>
</tr>
<tr>
<td>General Chemistry—Chem 142, 142L or 148, 148L</td>
<td>4</td>
</tr>
<tr>
<td>Introductory Food Technology—For Tch 114</td>
<td>4</td>
</tr>
<tr>
<td>Electives or specialization</td>
<td>3</td>
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</table>

<table>
<thead>
<tr>
<th>Spring</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Principles of Biology—For 101</td>
<td>3</td>
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<tr>
<td>Experimental Biology—For 101A</td>
<td>2</td>
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<tr>
<td>Physical education</td>
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</tr>
<tr>
<td>Electives or specialization</td>
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</table>

SOPHOMORE YEAR

<table>
<thead>
<tr>
<th>Fall</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Environmental Biology—For 103</td>
<td>3</td>
</tr>
<tr>
<td>Principles of Statistics—Stat 201</td>
<td>5</td>
</tr>
<tr>
<td>Fundamentals of Speech—Sp 211</td>
<td>3</td>
</tr>
<tr>
<td>Electives or specialization</td>
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<table>
<thead>
<tr>
<th>Winter</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>Basic Food Industries—For Tch 202</td>
<td>3</td>
</tr>
<tr>
<td>General Bacteriology—For 300</td>
<td>5</td>
</tr>
<tr>
<td>American Government—For S 215</td>
<td>5</td>
</tr>
<tr>
<td>Principles of Economics—Econ 241</td>
<td>3</td>
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</table>

<table>
<thead>
<tr>
<th>Spring</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>Sensory Evaluation of Food—For &amp; N 304</td>
<td>3</td>
</tr>
<tr>
<td>Principles of Economics—Econ 242</td>
<td>3</td>
</tr>
<tr>
<td>Electives or specialization</td>
<td>10</td>
</tr>
</tbody>
</table>

Typical Program for the First Two Years

FRESHMAN YEAR

<table>
<thead>
<tr>
<th>Fall</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Precalculus Mathematics—Math 109</td>
<td>5</td>
</tr>
<tr>
<td>Principles of Biology—For 101</td>
<td>3</td>
</tr>
<tr>
<td>Experimental Biology—For 101A</td>
<td>3</td>
</tr>
<tr>
<td>General Chemistry—Chem 141, 141L</td>
<td>4</td>
</tr>
<tr>
<td>Library Instruction—Lib 160</td>
<td>1</td>
</tr>
<tr>
<td>Orientation—For 110</td>
<td>1</td>
</tr>
<tr>
<td>Physical education</td>
<td>1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Winter</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction to Forest and Outdoor Recreation Resource Management—For 101</td>
<td>4</td>
</tr>
<tr>
<td>Language in Composition and Reading—Engl 104</td>
<td>4</td>
</tr>
<tr>
<td>General Chemistry—Chem 142, 142L</td>
<td>4</td>
</tr>
<tr>
<td>Intuitive Calculus—Math 161</td>
<td>3</td>
</tr>
<tr>
<td>Physical education</td>
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</tbody>
</table>
### Typical Program for the First Two Years

**FRESHMAN YEAR**

<table>
<thead>
<tr>
<th>Session</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Fall</strong></td>
<td></td>
</tr>
<tr>
<td>Principles of Biology—Biol 101</td>
<td>3</td>
</tr>
<tr>
<td>Principles of Economics—Econ 241</td>
<td>3</td>
</tr>
<tr>
<td>Experimental Biology—Biol 101A</td>
<td>3</td>
</tr>
<tr>
<td>Language in Composition and Reading—Engl 104</td>
<td>4</td>
</tr>
<tr>
<td>Principles of Economics—Econ 242</td>
<td>3</td>
</tr>
<tr>
<td>Principles of Horticulture—Hort 110A</td>
<td>3</td>
</tr>
<tr>
<td>Language in Composition and Reading—Engl 105</td>
<td>4</td>
</tr>
<tr>
<td>Principles of Horticulture—Hort 110B</td>
<td>3</td>
</tr>
<tr>
<td>Library Instruction—Lib 160</td>
<td>1</td>
</tr>
<tr>
<td>Physical education</td>
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</table>

<table>
<thead>
<tr>
<th>Winter</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>General Botany—Bot 107</td>
<td>3</td>
</tr>
<tr>
<td>General Chemistry—Chem 141, 141L</td>
<td>4</td>
</tr>
<tr>
<td>General Chemistry—Chem 142, 142L</td>
<td>4</td>
</tr>
<tr>
<td>General Zoology—Zool 106</td>
<td>5</td>
</tr>
<tr>
<td>General Psychology—Psych 101</td>
<td>3</td>
</tr>
</tbody>
</table>

**SOPHOMORE YEAR**

<table>
<thead>
<tr>
<th>Session</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Fall</strong></td>
<td></td>
</tr>
<tr>
<td>Principles of Economics—Econ 241</td>
<td>3</td>
</tr>
<tr>
<td>Plant Propagation—Hort 214</td>
<td>3</td>
</tr>
<tr>
<td>Finite Mathematics—Math 104</td>
<td>5</td>
</tr>
<tr>
<td>Electives and minor credits</td>
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</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Winter</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elementary Organic Chemistry—Chem 231, 232A</td>
<td>5</td>
</tr>
<tr>
<td>Principles of Economics—Econ 242</td>
<td>3</td>
</tr>
<tr>
<td>Foundations and Frontiers of Physics—Phys 101</td>
<td>4</td>
</tr>
<tr>
<td>Electives and minor credits</td>
<td>5</td>
</tr>
</tbody>
</table>

**SOPHOMORE YEAR**

<table>
<thead>
<tr>
<th>Session</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Fall</strong></td>
<td></td>
</tr>
<tr>
<td>Principles of Economics—Econ 241</td>
<td>3</td>
</tr>
<tr>
<td>Plant Propagation—Hort 214</td>
<td>3</td>
</tr>
<tr>
<td>Finite Mathematics—Math 104</td>
<td>5</td>
</tr>
<tr>
<td>Electives and minor credits</td>
<td>5</td>
</tr>
</tbody>
</table>

### Curriculum in Horticulture

Students majoring in horticulture are required to select a minor in business, education, science, or technical specialties.

**Degree Requirements**

<table>
<thead>
<tr>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>I. Communications—Engl 104, 105; Lib 160; Sp 211</td>
</tr>
<tr>
<td>II. Mathematical sciences—Math 104; Stat 104</td>
</tr>
<tr>
<td>III. Physical sciences—Chem 141, 141L, 142, 142L, 231, 232A; Phys 101</td>
</tr>
<tr>
<td>IV. Biological sciences—B &amp; B 301; Biol 101, 101A; Bot 107, 310, 407; Zool 106, 376; Gen 340</td>
</tr>
<tr>
<td>V. Social sciences—Econ 241, 242; Pol S 215; Psych 101</td>
</tr>
<tr>
<td>VI. Humanities</td>
</tr>
<tr>
<td>VII. Horticultural sciences—Hort 110, 114A, 114B, 154, 214, 401, 402, 403; horticultural electives (18 cr.)</td>
</tr>
<tr>
<td>VIII. Agricultural sciences—Agron 154, 354</td>
</tr>
<tr>
<td>IX. Physical education</td>
</tr>
<tr>
<td>X. Electives and minor credits</td>
</tr>
</tbody>
</table>

**TOTAL** 192

### Curriculum in Landscape Architecture

Accredited by the American Society of Landscape Architects.

**Degree Requirements**

<table>
<thead>
<tr>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>I. Communications—Engl 104, 105; Lib 160; electives</td>
</tr>
<tr>
<td>II. Mathematical sciences</td>
</tr>
<tr>
<td>III. Physical sciences</td>
</tr>
<tr>
<td>IV. Biological sciences—Biol 101, 103 electives</td>
</tr>
<tr>
<td>V. Social sciences</td>
</tr>
<tr>
<td>VI. Humanities</td>
</tr>
<tr>
<td>VII. Engineering—C E 211A, 214; civil engineering electives</td>
</tr>
<tr>
<td>VIII. Urban planning</td>
</tr>
<tr>
<td>IX. Forestry or horticulture or soils electives</td>
</tr>
<tr>
<td>X. Architecture</td>
</tr>
</tbody>
</table>
XI. Landscape architecture—L A 110, 112, 113, 201, 213, 231, 232, 233, 251, 311, 334, 352, 404, 411, 422; electives ........................................ 61
XII. Physical education .......................................................... 3
XIII. Free electives ................................................................... 23

TOTAL ...................................................... 192

Typical Program for the First Two Years

FRESHMAN YEAR

Fall
Principles of Biology—Biol 101 .................................................. 3
Language in Composition and Reading—Engl 104 ............................ 4
Orientation in Landscape Architecture—L A 110 ................................ R
Graphic Communication—L A 112 .............................................. 3
Library Instruction—Lib 160 ...................................................... 1
Social science elective ................................................................ 3
Physical education .................................................................... 1

Winter
Environmental Biology—Biol 103 ................................................. 3
History of Landscape Architecture I—L A 201 ................................ 3
Mathematical science elective ...................................................... 6
Physical science elective .............................................................. 4
Physical education .................................................................... 1

Spring
Language in Composition and Reading—Engl 105 ............................ 4
Landscape Perception—L A 113 ................................................... 4
Mathematical science elective ...................................................... 3
Physical science elective .............................................................. 4
Physical education .................................................................... 1

SOPHOMORE YEAR

Fall
Elementary Surveying—C E 211A ................................................ 3
English or speech elective ............................................................ 3
Theory of Landscape Design—L A 213 ......................................... 4
Plant Materials I—L A 231 .......................................................... 3
Social science elective ................................................................. 3

Winter
Photo, Route and Land Survey—C E 214 ...................................... 3
English or speech elective ............................................................ 3
Fundamentals of Planting Design—L A 232 ................................ 4
Materials and Fundamentals of Construction—L A 235 .................. 4
Elective ....................................................................................... 3

Spring
Forestry or horticulture or soils elective ...................................... 3
Plant Materials II—L A 238 .......................................................... 4
Physical science elective .............................................................. 3
Social science elective ................................................................. 3
Elective ....................................................................................... 3

Typical Program for the First Two Years

FRESHMAN YEAR

Fall
Precalculus Mathematics—Math 109 ........................................... 5
Principles of Biology—Biol 101 .................................................... 3
Experimental Biology—Biol 101A ............................................... 3
General Chemistry—Chem 141, 141L ........................................... 4
Library Instruction—Lib 160 ...................................................... 1
Orientation—For 110 ................................................................. R
Physical education .................................................................... 1

Winter
Introduction to Forestry and Outdoor Recreation Resource Management—For 101 ................................................................. 4
Language in Composition and Reading—Engl 104 ............................ 4
General Chemistry—Chem 142, 142L ........................................... 4
Intuitive Calculus—Math 161 ...................................................... 3
Physical education .................................................................... 1

Spring
General Botany—Bot 107 ............................................................ 5
Language in Composition and Reading—Engl 105 ............................ 4
Intuitive Calculus—Math 162 ...................................................... 3
Rural Institutions and Organizations—Soc 130 ............................... 4
Physical education .................................................................... 1

SOPHOMORE YEAR

Fall
Principles of Economics—Econ 241 ............................................. 3
Publicity and Public Relations—J 1225 ......................................... 3
American Government—Pol 215 ................................................ 3
Environmental Biology—Biol 103 ................................................. 3
Foundations and Frontiers of Physics—Phys 101 ........................... 4

Winter
Principles of Economics—Econ 242 ............................................. 3
Computer Programming—Com S 201 ......................................... 3
Introduction to Statistics—Stat 104 ............................................. 3
Fundamentals of Soils—Agron 154 ............................................... 4

Spring
Fundamentals of Speech—Sp 211 ................................................. 3
Outdoor Recreation and Resource Management—For 286 ............... 3
Theory of Landscape Design—L A 213 ......................................... 3
Basic Ecology—Biol 309 ............................................................ 4
Humanities ............................................................................... 3

Curriculum in Outdoor Recreation Resources

Administered by the Department of Forestry.

Degree Requirements

Credits
I. Communications—Lib 160; Engl 104, 105; J 1225; Sp 211 ............... 15
II. Mathematical sciences—Math 109, 161, 162; Com S 201; Stat 104 .......... 20

III. Physical sciences—Chem 141, 141L, 142, 142L; Phys 101; Geol 230 ........ 15
IV. Biological sciences—Biol 101, 101A, 103, 309; Bot 107; L A 231; Zool 342, 461 .......... 28
V. Social sciences—Soc 130, 483; Pol S 215; Econ 241, 242; electives ........... 22
VI. Humanities ........................................................................ 6
VII. Forestry and outdoor recreation resources—For 101, 360, 301, 302, 344, 414, 451, 452, 453, 454 .......... 34
VIII. Other courses—Agron 154; L A 213, 445 .......................... 11
IX. Physical education ......................................................... 3
X. Required minor .................................................................... 20
XI. Free electives ................................................................. 18

TOTAL .............................................. 192
Curriculum in Plant Pathology

Administered by the Department of Botany and Plant Pathology.

Degree Requirements

| I. Communications—Engl 104, 105; Sp 211; Lib 160; electives | 15 |
| II. Mathematical sciences—Stat 101; electives | 12 |
| III. Physical sciences—Chem 141, 141L, 142, 142L; or 147, 147L, 148, 148L; Phys 111 or 221; electives | 16 |
| IV. Biological sciences—Biol 101, 101A, 103; Bot 107; Zool 106 | 18 |
| V. Social sciences—Econ 241, 242; Pol S 215; electives | 15 |
| VI. Humanities—history, English (literature); electives | 15 |
| VII. Agricultural sciences—Agron 154, 206; electives | 10 |
| VIII. One or two minor areas of study | 20 or 30 |
| IX. Plant pathology—Bot 306, 320, 404, 407 or 416; Bact 300; Gen 350; Zool 370 or 376; electives | 30 |
| X. Physical education | 3 |
| XI. Free electives | 38 or 28 |

TOTAL 192

Typical Program for the First Two Years

FRESHMAN YEAR

Fall
Language in Composition and Reading—Engl 104 ..................................... 4
Mathematics requirement .................................................................................. 5
Principles of Biology—Biol 101 ....................................................................... 3
Experimental Biology—Biol 101A ................................................................. 2
Library Instruction—Lib 160 .......................................................................... 1
Physical education ............................................................................................ 1

Winter
General Chemistry—Chem 141, 141L; or 147, 147L .................................. 4
Mathematics requirement ................................................................................ 5
Environmental Biology—Biol 103 ................................................................. 3
General Botany—Bot 107 ................................................................................ 5
Physical education ............................................................................................ 1

Spring
Language in Composition and Reading—Engl 105 ................................ 4
General Chemistry—Chem 142, 142L; or 148, 148L ................................ 4
Principles of Statistics—Stat 101 (5 cr.) or minor requirements (5 cr.) .... 5
Fundamentals of Soil Science—Agron 154 .................................................. 4
Technical Lecture—Bot 110 .......................................................................... R
Physical education ............................................................................................ 1

SOPHOMORE YEAR

Fall
Agricultural science requirement .................................................................. 3
Principles of Economics—Econ 241 (3 cr.) or social science requirement (3 cr.) .... 3
General Zoology—Zool 106 ........................................................................... 5
Physical science requirement ........................................................................ 4
Electives ......................................................................................................... 9

Spring
Plant Taxonomy—Bot 306 ........................................................................... 4
Fundamentals of Speech—Sp 211 .................................................................. 3
Social science requirement ............................................................................ 3
Humanities requirement .............................................................................. 3
Electives or minor requirements .................................................................. 3

TOTAL 192

Typical Program for the First Two Years

FRESHMAN YEAR

Fall
Principles of Biology—Biol 101 .................................................................... 3
Biology of Organisms—Biol 102A .................................................................. 2
General Chemistry—Chem 141, 141L .......................................................... 4
Finite Mathematics—Math 104 .................................................................... 5
Physical education .......................................................................................... 1
Library Instruction—Lib 180 .......................................................................... 1
Orientation to Public Service Administration in Agriculture—Soc 110 ....... R
Curriculum in Urban Planning

Administered by the Department of Landscape Architecture.

Planning areas of specialization include: administration, city as a system, economic planning, environmental planning, housing and urban renewal, human resource planning, policy development and planning, state and regional planning, transportation planning, urban design, and urban information systems.

Degree Requirements

<table>
<thead>
<tr>
<th>Area</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>I. Communications—Engl 104, 105; Sp 221; Lib 160;</td>
<td>12</td>
</tr>
<tr>
<td>II. Mathematical sciences—Math 104; Stat 101; computer science elective;</td>
<td>13</td>
</tr>
<tr>
<td>III. Physical sciences;</td>
<td>11</td>
</tr>
<tr>
<td>IV. Biological sciences—Biol 101, 102A, 102B, 103;</td>
<td>10</td>
</tr>
<tr>
<td>V. Social sciences—Econ 241, 242; Soc 134; Pol S 215; Econ 461, 462;</td>
<td>18</td>
</tr>
<tr>
<td>VI. Humanities—Sequence in history, literature or philosophy;</td>
<td>9</td>
</tr>
<tr>
<td>VII. Urban planning—Ur Pl 110, 112, 153, 210, 270, 272, 310, 380, 383, 395, 432, 433, 492, 499;</td>
<td>39</td>
</tr>
</tbody>
</table>

VIII. Other required courses—architectural elective (3); transportation electives (10); landscape architecture electives (9); minor (19); planning specialty (12); group electives (12). 65
IX. Physical education .................. 3
X. Free electives ........................ 12

TOTAL 192

Typical Program for the First Two Years

FRESHMAN YEAR

Fall
Biological science electives .............................................. 5
Physical science elective .................................................. 4
Orientation in Urban Planning—Ur Pl 110 ................................... R
Library Instruction—Lib 160 .............................................. 1
Physical education ....................................................... 1

Winter
Biological science electives .............................................. 5
Finite Mathematics—Math 104 .............................................. 5
Language in Composition and Reading—Engl 104 ......................... 4
Survey of Urban Planning—Ur Pl 153 ..................................... 3

Spring
Foundations and Frontiers of Physics—Phys 101 ......................... 4
Physical education ....................................................... 1

SOPHOMORE YEAR

Fall
Principles of Economics—Econ 241 ................................. 3
American Government—Pol S 218 ........................................ 3
Architecture elective ..................................................... 3
Fundamentals of Speech—Sp 211 ........................................ 3
Humanities elective ..................................................... 3
Planning Seminar—Ur Pl 210 ............................................ 1

Winter
Forces Shaping Our Urban Environment—Ur Pl 270 .................... 3
Principles of Economics—Econ 242 .................................... 3
Principles of Statistics—Stat 101 .................................... 5
Humanities elective ..................................................... 3
Group elective .......................................................... 3

Spring
Planning Techniques—Ur Pl 272 ....................................... 4
Landscape architecture elective ........................................ 4
Group electives .......................................................... 6
Humanities elective ..................................................... 3

Training for Extension Service

Students interested in preparing for work in the Extension Service may be referred to an extension adviser who is a member of the Extension Service staff. By cooperation between the extension adviser and the student's departmental adviser, the following courses may be recommended for substitution in place of required courses or used as electives in the student's curriculum. The program indicates the quarter in which it would be desirable to take the recommended courses, although the courses might be
taken in other quarters. This program should be planned not later than the sophomore year. Such students will remain in one of the regular subject matter curricula. Other courses may be suggested in addition to or in lieu of the following courses depending upon the specific area of interest with the Extension Service.

**SOPHOMORE YEAR**

<table>
<thead>
<tr>
<th>Term</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fall</td>
<td>General Psychology—Psych 101</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Observation and Survey of Program of Education in Agriculture—Ag Ed 211B</td>
<td>1</td>
</tr>
<tr>
<td>Winter</td>
<td>Introduction to Sociology*—Soc 134</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Developmental Psychology—Psych 230</td>
<td>3</td>
</tr>
<tr>
<td>Spring</td>
<td>Educational Psychology—Psych 333</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Methods of Teaching—Educ 305</td>
<td>3-4</td>
</tr>
</tbody>
</table>

**JUNIOR YEAR**

<table>
<thead>
<tr>
<th>Term</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fall</td>
<td>Sociological Inquiry and Social Organization—Soc 201</td>
<td>5</td>
</tr>
<tr>
<td>Winter</td>
<td>Group Dynamics—Soc 364</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Publicity and Public Relations—Jl 225</td>
<td>3</td>
</tr>
</tbody>
</table>

**SENIOR YEAR**

<table>
<thead>
<tr>
<th>Term</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fall</td>
<td>Extension Education—Educ 468</td>
<td>3</td>
</tr>
<tr>
<td>Winter</td>
<td>Community Action—Soc 464</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Leadership and Social Interaction—Soc 468</td>
<td>3</td>
</tr>
<tr>
<td>Spring</td>
<td>Business Communication—Engl 404</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Business and Professional Speaking—Sp 312</td>
<td>3</td>
</tr>
</tbody>
</table>

*Soc 130, if required in the student's curriculum, will meet this need.

**Preparation for Graduate Study**

The student who expects to earn an advanced degree in an area of technical agriculture should take some of the more fundamental courses indicated below. In addition to these strongly recommended courses, students will find calculus, physical chemistry, genetics, bacteriology, botany, and zoology to be valuable. Students should consult their advisers in determining the extent to which they might substitute these fundamental courses for the more applied courses required in their curriculum.

A knowledge of statistics and the principles of technical writing is essential in the preparation of a thesis, which is required for the degree Master of Science or Doctor of Philosophy in agriculture. Graduate students usually are required to have a reading knowledge of French, Spanish, Russian, or German.

**SOPHOMORE YEAR**

<table>
<thead>
<tr>
<th>Term</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fall</td>
<td>Organic Chemistry—Chem 334</td>
<td>3</td>
</tr>
<tr>
<td>Winter</td>
<td>Organic Chemistry—Chem 335</td>
<td>3</td>
</tr>
<tr>
<td>Spring</td>
<td>Analytic Geometry and Calculus I—Math 120</td>
<td>5</td>
</tr>
</tbody>
</table>

**JUNIOR YEAR**

<table>
<thead>
<tr>
<th>Term</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fall</td>
<td>Quantitative Analysis—Chem 211</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>General Physics—Phys 111</td>
<td>4</td>
</tr>
<tr>
<td>Winter</td>
<td>General Physics—Phys 112</td>
<td>4</td>
</tr>
<tr>
<td>Spring</td>
<td>Writing of Reports and Technical Papers—Engl 414</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>General Physics—Phys 113</td>
<td>4</td>
</tr>
</tbody>
</table>

**Training for International Service**

Agricultural students desiring to work in foreign countries with private industry, governmental agencies, or private foundations and institutions are referred to the section headed *International Studies Programs* for suggested courses they might take as electives or as substitutes for required courses.
College of Education

An effective teacher needs broad personal and professional knowledge and understanding. The College of Education strives to provide each prospective teacher with a sound general education and background as well as preparation in an area of specialization. With these must go an understanding of teaching and of learning, and a skill in applying such understanding in the classroom, plus an awareness of the characteristics of growth and development of students and society.

All students who are recommended by Iowa State University for teacher certification must be recommended by the College of Education. However, each student will be enrolled in the department in which he or she plans to major, and must meet the graduation requirements of that department and the college in which it is located.

Within the College of Education, courses are offered in education for all undergraduate students seeking teaching certificates for the elementary and secondary schools. In addition, certain undergraduate nonteaching programs and several professional programs at the graduate level are offered. All degree programs are accredited by The National Council for Accreditation of Teacher Education.

Admission to Undergraduate Program

A student seeking admission to a teacher education program must be accepted by a selection committee for the specific program which he or she seeks to enter. Factors considered in evaluating applications include scholarship, interest in teaching, character, and physical and mental health. Recommendations by selection committees must be confirmed by the Committee on Academic Standards of the College of Education before admittance to the program in teacher education is granted.

Students should apply at least four quarters before the one in which they plan to enroll in student teaching. A 2.3 quality point average is required for admittance to the teacher education program, and this minimum average must be maintained through graduation.

Teacher Certification

The Iowa Professional Certificate may be recommended for those who hold the bachelor’s degree from Iowa State and who have completed the following:

1. All requirements of an approved teacher education program.
2. A minimum of 75 credits in courses designed to serve the general needs of college students.

For full-time teaching in secondary schools an approved subject matter concentration of at least 45 credits is required. A second subject matter area of at least 30 credits for half-time teaching is possible but not required.

Approval for the elementary certificate requires the successful completion of the curriculum in elementary education.

Approval for the nursery school-kindergarten certificate requires the successful completion of that curriculum in the Department of Child Development.

Graduate programs are available for those who seek approval as elementary and secondary school principals, superintendents, school psychologists, counselors, or teachers in junior and community colleges.

Information concerning certificates not described above, as well as more detailed requirements for any certificate, may be obtained from the Dean of the College of Education.

The General Education Requirement

All prospective teachers are required to complete a program in general education which is integrated with their professional training and extends through the undergraduate curriculum.

The general education program emphasizes intellectual growth and personal development as contrasted with specific vocational preparation. It is recognized that many contributions to general education may be made by courses which have other primary objectives.

The program aims to stimulate a desire for learning and intellectual endeavor, develop understanding and appreciation for the physical and cultural world, encourage independent thinking and analysis, increase competence in all aspects of communication, and create an understanding of man as a social, psychological, and physical being.

The student is expected to complete studies in five groupings in general education. Areas represented below are not departmental titles. In some cases, courses relating to a given area may be found in several different departments.

<table>
<thead>
<tr>
<th>Area</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>I. Physical sciences and mathematics</td>
<td>9-21</td>
</tr>
<tr>
<td>II. Biological sciences</td>
<td>9-21</td>
</tr>
<tr>
<td>III. Social sciences</td>
<td>9-21</td>
</tr>
<tr>
<td>IV. Humanities</td>
<td>9-21</td>
</tr>
<tr>
<td>V. Communicative arts</td>
<td>14-21</td>
</tr>
</tbody>
</table>
A minimum total of 75 credits must be earned in general education, with the minimum and maximum in each group as shown above. This total will include Engl 104 and 105, Sp 211, Psych 230, and one course in American history or political science.

A course may not be counted in general education and also in the academic departments preparing teachers. Additional credits in general education may be required by departments preparing teachers.

The Professional Education Requirement

As part of a total educational program, the prospective teacher must complete certain studies related directly to the profession of teaching. All students in teacher education take the following courses:

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Foundations of American Education-Educ 204</td>
<td>3</td>
</tr>
<tr>
<td>Methods of Teaching-Educ 305B</td>
<td>1</td>
</tr>
<tr>
<td>Educational Psychology-Psych 333</td>
<td>5</td>
</tr>
</tbody>
</table>

The additional courses required by specific teaching areas are:

Elementary Education

See Curriculum in Elementary Education.

Nursery-Kindergarten Education

See Index, Child Development for complete requirements.

Secondary Education


Professional Courses in Areas of Specialization

Agricultural Education—Ag Ed 211, 321, 412, 414, 417.
Art—A A 415, 416, 417, 418.
Biology—D St 417D, 486.
Chemistry—D St 417B, 486.
Earth Science—D St 417J, 486.
English—Engl 494, D St 417E.
Foreign Languages—FL 476, D St 417G.
General Science—D St 417B, 486.
Industrial Education—I Ed 415, 417.
Journalism—Ill 490, D St 417L.
Mathematics—Math 497, D St 417C.
Music—Music 366, 466, D St 417K and/or 317L.
Physical Education for Men—P E M 497, D St 417F.
Physical Education for Women—P E W 417, or 417 and 418.
Bacteriology—300.
Biochemistry and Biophysics—301 or 401; or 404, 405, 406.
Biology—101, 101A, 103, 309.
Botany—107; 306 or 203 or 301L; 310 or 320 or 404.
Genetics—340 or 350 or 400.
Zoology—106; 155 and 166, or 455; 320 or 334 or 358.
One course from Bact 320; Biol 303 or 438; Bot 304; C Biol 428; Zool 200, 307, 311, 370, 302L.

The Requirements for Areas of Specialization

A teacher must also be competent in the area of a teaching specialization. Certain competencies are required of those who would teach at nursery-kindergarten or the elementary level, for instance, while a depth of knowledge in some particular subject matter is necessary for those who would be teachers at the secondary level.

All the minimal number of subject matter credits in an area of specialization in the College of Sciences and Humanities should carry a grade of “C” or better. Required credits in the area of specialization which carry a grade of “F” or “D” must be repeated with a grade of at least “C” or, with the approval of the area supervisor, may be supplemented with an equal number of credits which carry a grade of at least “C” and are in the same area and beyond the minimal requirement. Exceptions may be approved by the area supervisor if the grade point in the area of specialization is at least 2.5.

Elementary Education

See Curriculum, Elementary Education.

Nursery Education

See Curriculum, Child Development.

Vocational Agriculture

See Curriculum, Agriculture.

Applied Art


Biology

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

Bacteriology—300.
Biochemistry and Biophysics—301 or 401; or 404, 405, 406.
Biology—101, 101A, 103, 309.
Botany—107; 306 or 203 or 301L; 310 or 320 or 404.
Genetics—340 or 350 or 400.
Zoology—106; 155 and 166, or 455; 320 or 334 or 358.
One course from Bact 320; Biol 303 or 438; Bot 304; C Biol 428; Zool 200, 307, 311, 370, 302L.

Chemistry

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

Chemistry—141, 141L, 142, 142L, 211; or 147, 147L, 148, 148L and 211; or 114 and 116 and 120; 301; 334 and 335 and 337 to accompany 336, or 331 and 332 and 330 to accompany 331 and 332; 321 and 322 and 322L; or 224 and 325 and 327A, or 493 and 494.
Biochemistry—301.
Physics—221, 222, 223.
Students seeking restricted approval to teach chemistry
must earn credits in the following courses:

Chemistry—141, 141L, 142, 142L, 211; or 147, 147L, 148, 148L, 211; or 114, 115, 120; 334, 335 and 337 to accompany 335, or 331 and 332, and 330 to accompany 331, 322; 321 or 224 (permission of instructor required to take 321 or 224 without physics prerequisite); or 493 and 494 (no physics prerequisite).

Physics—221.

Earth Science

Students seeking approval to teach earth science
must earn a minimum of 45 credits in the following courses:

Geology—100; 201 or 200 or 230; 204; 271 or 351; 302 (Field Course, 8-12 cr.).
Meteorology—206.
Physics—151, 152.
Geography—201; 12 credits in any combination of agronomy, astronomy, geography, geology, and meteorology courses numbered 300 or above.

Students seeking restricted approval to teach earth science
must earn a minimum of 30 credits in the following courses:

Geology—100, 204; 271 or 351; 201 or 200 or 230.
Meteorology—206.
Physics—151, 152.
Geography—201; 6 credits in any combination of agronomy, astronomy, geography, geology, and meteorology courses numbered 300 or above.

English

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

Linguistics and composition—Engl 219 and 419 or 420; 496, and 3 credits chosen from 204, 304A, 304B; 6 additional credits chosen from Engl 419, 420, 204, 304A, 304B, 306A, 306B; Sp 305; Psych 385.

Literature—Engl 201; 354A or 356; 12 credits chosen from British and American literature period sequences; 12 credits chosen from 450 series, 489, 490.

Students who are not English majors should consult with English advisers about selection and distribution of courses.

Foreign Languages

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

French majors must include—204, 311, 312, 313, 314, 315, 316.
German majors must include—336, 337, 338, 339, 340, 341.
Spanish majors must include—354, 356, 356, 357, 358, 359.
Russian majors must include—324, 325, 326, 327, 328, 329.

Students seeking restricted approval to teach a foreign language must earn 30 credits in that language. Nine of the 30 credits must be in composition and conversation.

Prior to receiving either full or restricted approval, the candidate must demonstrate adequate speaking proficiency in the language to be taught.

General Science

Students seeking approval to teach general science
must complete one of the following five alternate sets of requirements.

1. The student must complete full approval to teach biology and must earn credits in the following courses:

Physics—111, 112, 113; or 221, 222, 223.
Geology—100.
Chemistry—141, 141L, 142, 142L; or 147, 147L, 148, 148L; or 114, 115.

2. The student must complete full approval to teach chemistry and must earn credits in the following courses:

Botany—107.
Biology—101, 101A.
Geology—100.
Meteorology—206, 208.
Zoology—106, 156, and 156.

3. The student must complete full approval to teach earth science and must earn credits in the following courses:

Botany—107.
Biology—101, 101A.
Chemistry—141, 141L, 142, 142L; or 147, 147L, 118, 148L; or 114, 115.
Physics—111, 112; or 221, 222, 223.
Zoology—106, or 156 and 156.

4. The student must complete full approval to teach physics and must earn credits in the following courses:

Botany—107.
Biology—101, 101A.
Geology—100.
Meteorology—206, 208.
Zoology—106, or 156 and 156.

5. The student must earn credits in the following courses:

Biology—101, 101A, 103.
Botany—107.
Zoology—106, or 156 and 156.
Chemistry—141, 141L, 142, 142L; or 147, 147L, 118, 148L; or 114, 115.
Geology—100.
Physics—111, 112, 113; or 221, 222, 223.
Meteorology—206, 208.
Physics—151, 152; or 344, 346; at least 3 credits in genetics or bacteriology; at least 6 additional credits from courses numbered 300 or above in bacteriology, biochemistry and biophysics, biology, botany, chemistry, genetics, geology, meteorology, physics, and zoology.

Home Economics

See Curriculum, Home Economics.

Industrial Education

See Curriculum, Industrial Education.

Journalism and Mass Communication

Students seeking approval to teach journalism must earn 35 credits as follows:

In addition to the journalism requirements, the student must earn a minimum of 10 credits in written and spoken English.

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

In addition to the journalism requirements, the student must earn a minimum of 10 credits in written and spoken English.

Mathematics

Students seeking approval to teach mathematics must earn credits in the following courses:
Mathematics—120, 121, 122, 223; or 130, 131, 132, 233; 201, 202, 301, 313; or 311, or 456, 469; 15 additional credits in courses numbered 200 or above.

Students seeking restricted approval to teach mathematics must earn credits in the following courses:
Mathematics—120, 121, 122, 223; or 130, 131, 132, 233; 201, 202, 301, 313; or 311, or 456, 469.

Music

Students seeking approval to teach music (kindergarten through grade 12) must earn credits in the following courses:
Child Development—228.
Elementary Education—344.
Music 3101 is required for students planning to teach vocal music.
Music 467, 468, 469, and 4 credits (two courses) from 387, 388, 389 are required for students planning to teach instrumental music.

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

Physical Education for Men

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

Hygiene—104, 105.
Physical Education for Men—200, 205, 212, 305, 320, 330, 359, 417*; 420, 494, 496.
Seven credits chosen from 312, 314, 315, 316, 317, 318, 319, 492.
Twelve credits chosen from PEM 105 through 158.

*These credits should be satisfied during the student teaching (D St 417P) experience and by participation in the after-school athletic program.

Students seeking endorsement to coach interscholastic athletics must earn credits in the following courses:
Physical Education for Men—320, 359, 417*, 420.
Five credits chosen from PEM 492, 494.

Physical Education for Women

See Curriculum, Physical Education for Women.

Physical Science

Students seeking approval to teach physical science must earn credits in the following courses:
The courses listed for restricted approval, plus completion of Physics 151, 152, 153, or Physics 344, 345. Three or 4 credits of organic chemistry.
Eight credits from courses numbered 200 and above in physics, chemistry, meteorology, and geology (except Geol 203).

Students seeking restricted approval to teach physical science must earn credits in the following courses:
Physics—111, 112, 113; or 221, 222, 223; and either 301, 302; or 331, 332.
Chemistry—141, 141L, 142, 142L; or 147, 147L, 148, 148L; or 114, 116.
Meteorology—206, 208.
Geology—100.
At least two credits from Phys 151 or 152 or 153 or 344 or 345.

Physics

Students seeking approval to teach physics must earn credits in the following courses:
Physics—221, 222, 223, 301, 302, 303, 311T, 344, 345, 399 (3 cr.).
Six credits from Phys 310, 394, 396.
Three additional credits in physics courses numbered 300 or above.

Students seeking restricted approval to teach physics must earn credits in the following courses:
Physics—221, 222, 223, 301, 302, 311T, 344, 345.

The specific course requirements for each area of specialization follow.

Elementary Education

See Curriculum, Elementary Education.

Nursery-Kindergarten

See Curriculum, Child Development.

Vocational Agriculture

See Curriculum, Agriculture.

Applied Art

Safety Education and Driver Education

All students who qualify for approval to teach safety education and driver education must have preparation in some major area of specialization. Such students then may obtain approval to teach safety education and driver education by earning the following credits:

Fifteen credits chosen from:
Industrial Education—218, 316, 317, 418, 419, 490S, 570, 571, 590M, 590S.

Education—501.

Fifteen credits chosen from C E 352, 450; Econ 305, 444, 446; Educ 502, 503, 556 and/or 557, 552, 558; F E 254; I Ed 362, 462; I Ed 421; I Ed 262, 310; JI 101; Psych 430, 440, 450, 461, 480, 550, 593, 540, 650, 650; Soc 473, 483.

Social Studies

For approval to teach social studies a student must receive approval to teach in three or more of the following areas: world history, American history, sociology, economics, American government, geography. For approval the student must earn 15 credits in each of the chosen fields as follows:

ECONOMICS

GEOGRAPHY—fifteen credits from:
Geography—201, 202, 322, 324, 325, 421.
Geology—100, 200, 201, 250.

SOCIOLOGY—Soc 134, Anthro 111. One course from each group:
Group 1: Soc 201, 302, 305, 310.

AMERICAN GOVERNMENT—fifteen credits from:

UNITED STATES HISTORY—fifteen credits with at least one course from each group:
Group 1: Hist 221, 382A, 462B, 462C, 471A, 474A, 477A.

WORLD HISTORY—fifteen credits with at least one course from each group:

Speech

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

Eighteen credits from other speech courses numbered 300 or above as well as the credits in Eng 104, 105 or their equivalent.

Psychology

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

Psychology—202 or 206; 280, 301, 333; 345 or 430 or 436 or 450 or 495; 380, 401, 440, 460, 491.
Statistics—101.
Ten additional credits to be selected from the following: anthropology, biological sciences (Biol 103, Zool 193, Gen 400), child development, history of science (Hist 430A, 430B, 430C), mathematics, Comp 8 201, philosophy of science (Phil 270A, 380), sociology.

Advisers for Areas of Specialization

Persons interested in teaching in one of the following areas should consult with the appropriate individual. Details of each area will be found in the appropriate departmental section.

ELEMENTARY EDUCATION
Jess Beard

NURSERY-KINDERGARTEN
Samuel Clark

SECONDARY EDUCATION
Agricultural Education—Harold Crawford.
Art—Dennis Dake.
Biology—Delma E. Harding.
Chemistry—Robert E. McCarley.
Earth Science—Fred DeLuca.
English—James W. Schwartz.
Mathematics—William Rudolph.
Music—Arthur G. Swift.
Physical Education for Men—Leo Schneider.
Physical Education for Women—Barbara E. Parker.
Physiology—James E. Dixon.
Psychology—John Bath.
Safety Education—Lillian C. Schwem.
Social Studies (economics, sociology, government, geography, and history)—Clair Keller.
Speech—Russell Myers.
Undergraduate Curricula in
the College of Education

Undergraduate students planning to major in
elementary education or industrial education will enroll in
the College of Education.

Students may also qualify through the College of
Education for approval to teach safety and driver educa-
cation; such students must also qualify for approval to
teach in some major area of work (see Index, Industrial
Education, Courses and Programs.)

Each student will have a faculty adviser in his
or her chosen curriculum to aid in planning a
program.

Curriculum in Elementary
Education

The curriculum in elementary education is planned
for students preparing to teach in grades kindergarten
through six. For additional information see Index,
Courses and Programs.

Total credits required—192.

Curriculum in Industrial
Education

The curriculum in Industrial Education is planned
for students preparing to teach or to enter industry.
The teaching option provides preparation for teachers
of industrial arts or vocational-technical education.
The industrial option prepares students for employ-
ment in business or industry, particularly in personnel
work, selling, communication, contracting and con-
struction, maintenance, or production.

Total credits required—192.

For additional information see Index.

III. Courses in the major

A. Child development ........................................ 58
   Principles of Child Development—CD 129 ............. 11
   Development and Guidance in the Child-
   hood—CD 226 ........................................ 4
   Guidance of Children—CD 442 .......................... 4

B. Elementary education ..................................... 19
   Principles of Teaching in Elementary
   Schools—El Ed 344A, 344B (laboratory) ............. 3
   The Teaching of Reading—El Ed 375 ..................... 6
   Elementary Education Methods I—El Ed
   445 (language arts and social studies) ............... 6
   Elementary Education Methods II—El Ed
   446 (mathematics—science) ............................ 4

C. Student teaching .......................................... 16
   Student Teaching in Primary Grades—
   Educ 467C ........................................... 8
   Student Teaching in the Intermediate
   Grades—Educ 467D .................................... 8

D. Related methods .......................................... 12
   Options—Music 365; P E W 470; Sp 375;
   A A 200; El Ed 447, 450, 455, 456;
   C D 240.

IV. Area of concentration ..................................... 24
Selection of courses from broad areas such as art,
communications, disadvantaged child, exceptional
child, learning disabled child, home economics, lan-
guages, mathematics, music, physical education, sci-
ences, and social studies. Student must select from
one area.

V. Electives .................................................... 22

VI. Library Instruction—Lib 160 ......................... 1

VII. Orientation ................................................ R
   Freshman Orientation—El Ed 100 ......................... R
   Sophomore Orientation—El Ed 200 ....................... R
   Transfer Orientation—El Ed 300 ......................... R

Credits

I. General education ......................................... 75
   A. Biological sciences ..................................... 9-21
      Principles of Biology—Biol 101 ...................... 3
      Zoology 166, or Biology 102A or 102B ............. 2
      Options—biology, botany, nutrition and
      zoology.
   B. Communicative arts ................................. 14-21
      Language in Composition and Reading—
      Engr 104, 105 ....................................... 8
      Fundamentals of Speech—Sp 211 ..................... 3
      Options—English, speech, journalism
   C. Humanities ............................................. 15-21
      Introduction to Literature—Engr 201 ............... 3
      History—any combination ............................ 6
      Options—art, history, literature, music,
      foreign language, philosophy.
   D. Physical sciences and mathematics ................. 17-21
      Mathematical Concepts—Math 190, and
      191 or 192 ......................................... 6
      Select one course in geography or meteor-
      ology.
      Options—select two: chemistry, geology, physics
   E. Social science .......................................... 18-21
      Principles of Economics—Econ 241 ................. 3
      American Government—Pol S 215 or 217 ............. 3 or 5
      Developmental psychology, Psych 230 ............. 4
      Introduction to Sociology—Soc 134 .................. 3
      Options—anthropology, economics, political
      science, psychology, sociology.
   II. Professional education core ......................... 9
      Foundations of American Education—Educ 204 .. 3
      Methods of Teaching (Audio-Visual Laboratory)—
      Educ 305B ........................................... 1
      Educational Psychology—Psych 333 .................. 5

Credits

I. General education ......................................... 75
   A. Physical Science and Mathematics ................. 17-21
      General Chemistry—Chem 140 and 140L,
      or 141 and 141L .................................... 4
      Mathematics ........................................... 9
      General Physics—Phys 111 ........................... 4
II. Industrial education core .................................................. 63
Technology and Application of Finishing Materials—I Ed 105 .......... 3
Exploration and Fundamental Fabrication of Wood—I Ed 106 .......... 3
Introduction to Industrial Education—
 I Ed 110 .............. 3
Drafting I—I Ed 121 .............. 3
Drafting II—I Ed 122 .............. 3
Drafting III—I Ed 123 .............. 3
Advanced Techniques of Wood Fabrication—
 I Ed 206 .............. 3
Industrial Arts Design—I Ed 220 .............. 3
Sheet Metal Fabrication—I Ed 232 .............. 3
Basic Metal Processes—I Ed 234 .............. 3
Machine Metals I—I Ed 236 .............. 3
Electricity I—I Ed 251 .............. 3
Electricity II—I Ed 253 .............. 3
Power Mechanics—An Introduction—
 I Ed 266 .............. 3
Power Mechanics—Internal Combustion Engines—I Ed 261 .... 3
Power Mechanics—The Automobile—
 I Ed 262 .............. 3
School Laboratory Safety—I Ed 310 .............. 3
Electronics I—I Ed 357 .............. 3
Introduction to Industrial Plastics—
 I Ed 370 .............. 3
Facility Planning and Organization—
 I Ed 410 .............. 3
Machine Construction—A E 358 .... 3

III. Options
A. Teaching option
1. Required ................................................................. 34-37
   Foundations of American Education—
   Educ 204 ......................................................... 3
   Methods of Teaching—Educ 305A ...................... 3
   Methods of Teaching—Educ 305B ...................... 1
   Principles of Secondary Education—
   Educ 426 .......................................................... 3
   Modern Materials, Design and Construction—
   I Ed 308 (3 cr.), or Architectural Drafting for Industrial Education
   Teachers—I Ed 324 (3 cr.), or Machine Metals II—I Ed 336 (3 cr.) ... 3 required
   Methods of Teaching Industrial Arts—
   I Ed 415 ............................................................... 3
   Observation and Supervised Student Teaching in Industrial Education—
   I Ed 417 ............................................................... 3-12
   Foundations of Vocational and Technical Education—I Ed 514 ........ 3
   Developmental Psychology—Psych 230 ............ 3
   Educational Psychology—Psych 333 ............ 3
2. Electives ................................................................. 13-16

B. Industrial option
1. Required ................................................................. 28-29
   Computer Programming—Com S 201 .... 3
   Labor Economics and Labor Relations—
   Econ 205 ........................................................... 3
   Business Communication—Engl 190, 205 (3 cr.),
   or Writing of Reports and Technical Papers—Engl 414 (3 cr.) ........ 3
   Industrial Accounting—I Ad 305 .......... 3
   Introduction to Industrial Engineering—
   I E 301 .......... 3
   Mathematics—120, 121, 122; or 190, 191, 192 sequences (5 cr.), or Principles of
   Statistics—Stat 105 (5 cr.) ...................... 5
   Foundations of American Education—
   Educ 204 ........................................................... 3
   Industrial Psychology I—Psych 460 ............ 3
   Business and Professional Speaking—
   Sp 312 (3 cr.), or Persuasion—Sp 327 (3 cr.),
   or Group Discussion—Sp 317 (3 cr.) ......... 8
2. Electives ................................................................. 21-22
   Students are encouraged to select electives from the following subject matter areas:
   architecture, computer science, economics, English, forestry, industrial administration,
   industrial engineering, journalism, mathematics, physics, psychology, speech.

IV. Physical education ....................................................... 8
V. Library Instruction—Lib 160 .............................................. 1
The engineer occupies a uniquely important position in our modern civilization. He or she has the responsibility for taking the discoveries of basic science and translating them into products, structures, facilities, and services for the use of mankind.

Objectives of Curricula in Engineering

The broad objectives of engineering education are to develop professional competence and, by breadth of study, to prepare students for participation as leaders in the affairs of their professions, their communities, the state, and the nation. Engineering education seeks to develop a capacity for objective and analytical thought.

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. Since engineers work on problems involving human relations, about one-fifth of the content of each engineering curriculum is in social sciences and humanities. These proportions meet the requirements recommended by the Engineers' Council for Professional Development, the national accrediting agency.

Registration as a professional engineer is required for many types of engineering positions. Such registration is granted by the individual states after the successful completion of an examination in engineering fundamentals, of four years of experience and of a final examination in engineering practice. The professional curricula at Iowa State University prepare a student for registration. Graduates from accredited curricula may take the first examination at the University shortly before graduation.

Advanced work in engineering is offered in the postgraduate programs. See the Graduate College section of this Catalog.

Curricula in College of Engineering

UNDERGRADUATE

Aerospace Engineering—4 yr. reg. & 5 yr. Co-op, B.S.*
Agricultural Engineering—4 yr. reg & 5 yr. Co-op, B.S.*

Architectural Engineering—4 yr. reg & 5 yr. Co-op, B.S.*
Biomedical Engineering—(graduate only)
Chemical Engineering—4 yr. B.S.*
Chemical Engineering—4 yr. reg. & 5 yr. Co-op, B.S.*
Civil Engineering—4 yr. reg. & 5 yr. Co-op, B.S.*
Construction Engineering—4 yr. reg. & 5 yr. Co-op, B.S.*
Electrical Engineering—4 yr. reg. & 5 yr. Co-op, B.S.*
Engineering Operations—4 yr. reg. & 5 yr. Co-op, B.S.*

Engineering Mechanics—(graduate only)
Engineering Science—4 yr. reg. & 5 yr. Co-op, B.S.*

Industrial Engineering—4 yr. reg. & 5 yr. Co-op, B.S.*
Mechanical Engineering—4 yr. reg. & 5 yr. Co-op, B.S.*
Metallurgical Engineering—4 yr. B.S. & 5 yr. Co-op, B.S.*
Nuclear Engineering—(graduate only)

GRADUATE

Aerospace Engineering—M.Eng., M.S., (Ph.D. joint major)
Agricultural Engineering—M.Eng., M.S., Ph.D.
Architecture—6 yr. M.Arch.*
Biomedical Engineering—M.S., Ph.D.
Ceramic Engineering—M.Eng., M.S., Ph.D.
Chemical Engineering—M.Eng., M.S., Ph.D.
Civil Engineering—M.Eng., M.S., Ph.D.
Construction Engineering—(undergraduate only)
Electrical Engineering—M.Eng., M.S., Ph.D.
Engineering Operations—(undergraduate only)
Engineering Mechanics—M.Eng., M.S., Ph.D.
Engineering Science—(undergraduate only)
Industrial Engineering—M.Eng., M.S., Ph.D.
Mechanical Engineering—M.Eng., M.S., (Ph.D. joint major)
Nuclear Engineering—M.S., Ph.D.

Curricula in College of Engineering

UNDERGRADUATE

Aerospace Engineering—4 yr. reg. & 5 yr. Co-op, B.S.*
Agricultural Engineering—4 yr. reg & 5 yr. Co-op, B.S.*

Architecture—4 yr. B.A.
Biomedical Engineering—(graduate only)
Chemical Engineering—4 yr. B.S.*
Chemical Engineering—4 yr. reg. & 5 yr. Co-op, B.S.*
Civil Engineering—4 yr. reg. & 5 yr. Co-op, B.S.*
Construction Engineering—4 yr. reg. & 5 yr. Co-op, B.S.*
Electrical Engineering—4 yr. reg. & 5 yr. Co-op, B.S.*
Engineering Operations—4 yr. reg. & 5 yr. Co-op, B.S.*

Engineering Mechanics—(graduate only)
Engineering Science—4 yr. reg. & 5 yr. Co-op, B.S.*

Industrial Engineering—4 yr. reg. & 5 yr. Co-op, B.S.*
Mechanical Engineering—4 yr. reg. & 5 yr. Co-op, B.S.*
Metallurgical Engineering—4 yr. B.S. & 5 yr. Co-op, B.S.*
Nuclear Engineering—(graduate only)

GRADUATE

Aerospace Engineering—M.Eng., M.S., (Ph.D. joint major)
Agricultural Engineering—M.Eng., M.S., Ph.D.
Architecture—6 yr. M.Arch.*
Biomedical Engineering—M.S., Ph.D.
Ceramic Engineering—M.Eng., M.S., Ph.D.
Chemical Engineering—M.Eng., M.S., Ph.D.
Civil Engineering—M.Eng., M.S., Ph.D.
Construction Engineering—(undergraduate only)
Electrical Engineering—M.Eng., M.S., Ph.D.
Engineering Operations—(undergraduate only)
Engineering Mechanics—M.Eng., M.S., Ph.D.
Engineering Science—(undergraduate only)
Industrial Engineering—M.Eng., M.S., Ph.D.
Mechanical Engineering—M.Eng., M.S., (Ph.D. joint major)
Nuclear Engineering—M.S., Ph.D.

*Accredited by the Engineers' Council for Professional Development (ECPD).
**Accredited by the National Architectural Accreditation Board.

Organization of Curricula

All curricula in engineering are divided into two phases: a basic program and a professional program. The basic program consists primarily of subjects fundamental and common to all branches of engineering and includes chemistry or physics, mathematics, engineering graphics, and English. A student
who has adequate high school preparation is expected
to complete the basic program in one year. The
professional phase of a curriculum includes intensive
study in the particular branch of engineering which
a student chooses as a major, as well as a continua-
tion of supporting work in mathematics, basic sci-
ces, humanities, and social sciences.

Preparation for the Engineering Curricula

A student who wishes to complete a particular
engineering curriculum in four years (six years in
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
and one-half year of trigonometry.

A student not having these prerequisites may
still enroll in the College of Engineering, but it may
take longer than four years to earn a degree. The
basic program in engineering is flexible with respect
to time, and courses in the basic program may be
adjusted to fit individual needs. Students are expected
to complete the requirements of the basic program
before proceeding to the professional engineering cur-
riculum of their choice.

Basic Program for Professional
Engineering Curricula

The basic (first year) program is much the same
for all professional curricula in the College of Engi-
nearing, and during the first year a student may
transfer from one department to another within the
college without undue loss of time. There are some
differences, however, and the student who desires to
receive the bachelor's degree in minimum time will
find it desirable to determine a major department as
soon as possible.

The basic program includes:*

| Mathematics 120, 121, 122; or 130, 131, 132 | 14 or 15 |
| English 104, 105 | 8 |
| Engineering Graphics 161, 162 | 6 |
| Chemistry 141, 141L or 147, 147L | 4 |
| Physics 221 | 5 |
| Engineering Problems (I'E 108) | 1 |
| Engineering Seminars (Engr 114, departmental seminar 100) | R |
| Library 160 | 1 |
| Departmental designated requirement** | 6 (minimum) |

**Departmental Designated Requirement

Aerospace Engineering—Phys 222, Stat 105
Agricultural Engineering—Chem 142, 142L, Agron 154
Ceramic Engineering—Chem 142, 142L, Soc 134, Socio-humanistic elective (3 cr.)
Construction Engineering—Chem 142, 142L, Soc 134, Socio-humanistic elective (3 cr.)
Chemical Engineering—Chem 142, 142L, 211
Civil Engineering—Chem 142, 142L, Stat 105
Electrical Engineering—Phys 222, Socio-humanistic elective (3 cr.)

The student's adviser may require or recommend
courses in addition to those specified above if the
preparation and progress of the student are such that
additional courses are necessary or desirable. Students
essentially must complete the basic program and have
at least a 2.00 cumulative average before being per-
mitted to enroll in courses offered in the College of
Engineering at the 200 level or above.

Reserve Officers Training Corps (ROTC)

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

Cooperative Education Programs

The College of Engineering offers, through certain
of its curricula, cooperative programs in which stu-
dents 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 experi-
ence is gained by working in industry during certain
periods each year. The student under a cooperative
program receives experience in a 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 experi-
ences which the cooperative student brings into the
classroom.

In general, students under these programs will
require one year more to complete the usual cur-
riculum 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 employ-
ing company and must not expect special treatment.
University holidays do not apply to cooperative stu-
dents, nor are students allowed time off for University
activities. A student may not enroll in classes at any
Curriculum in Aerospace Engineering

The purpose of the advising system in the College of Engineering is to work constructively with students in developing their individual academic program and to maintain close contact with students during their 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 the adviser to prepare an appropriate fall quarter program for the student.

Program in International Studies

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

Curriculum in Aerospace Engineering

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

See also Basic Program and Cooperative Programs.

SOPHOMORE YEAR

<table>
<thead>
<tr>
<th>Fall</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aerodynamics I—Aer E 244</td>
<td>3</td>
</tr>
<tr>
<td>Analytic Geometry and Calculus—Math 223 or 223</td>
<td>4-5</td>
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<tr>
<td>Introduction to Classical Physics—Phys 223</td>
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<tr>
<td>Introduction to Aerospace Engineering—Aer E 240</td>
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<td>Computer Programming—Com S 201</td>
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Total: 17-18

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<thead>
<tr>
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<tbody>
<tr>
<td>Aerodynamics II—Aer E 245</td>
<td>3</td>
</tr>
<tr>
<td>Elementary Differential Equations—Math 213</td>
<td>3</td>
</tr>
<tr>
<td>Statics of Engineering—E M 274</td>
<td>3</td>
</tr>
<tr>
<td>Metallurgy for Engineers—Met 231</td>
<td>3</td>
</tr>
<tr>
<td>Aerospace Laboratory—Aer E 271</td>
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<td>Socio-humanistic elective</td>
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Total: 16

JUNIOR YEAR

<table>
<thead>
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<th>Fall</th>
<th>Credits</th>
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<tbody>
<tr>
<td>Stability and Control I—Aer E 343</td>
<td>3</td>
</tr>
<tr>
<td>Aerospace Laboratory—Aer E 371</td>
<td>1</td>
</tr>
<tr>
<td>Mechanics of Materials I—E M 325</td>
<td>3</td>
</tr>
<tr>
<td>Dynamics II—E M 346</td>
<td>3</td>
</tr>
<tr>
<td>Introduction to Applied Mathematics II—Math 322</td>
<td>3</td>
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<td>Socio-humanistic elective</td>
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Total: 16

<table>
<thead>
<tr>
<th>Winter</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stability and Control II—Aer E 344</td>
<td>3</td>
</tr>
<tr>
<td>Aerospace Laboratory—Aer E 372</td>
<td>1</td>
</tr>
<tr>
<td>Flight Structures Analysis I—Aer E 320</td>
<td>3</td>
</tr>
<tr>
<td>Thermodynamics I—E M 321</td>
<td>4</td>
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<tr>
<td>Introduction to Circuits and Instruments—E E 441</td>
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<tbody>
<tr>
<td>Flight Mechanics I—Aer E 362</td>
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<tr>
<td>Aerospace Laboratory—Aer E 373</td>
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<tr>
<td>Flight Structures Analysis II—Aer E 321</td>
<td>3</td>
</tr>
<tr>
<td>Reaction Propulsion I—Aer E 309</td>
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<td>Socio-humanistic elective</td>
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Total: 16

SENIOR YEAR

<table>
<thead>
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<th>Fall</th>
<th>Credits</th>
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<tbody>
<tr>
<td>Senior Projects—Aer E 471</td>
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<tr>
<td>Design and Analysis I—Aer E 461</td>
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<td>Reaction Propulsion II—Aer E 411</td>
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<td>Fundamentals of Flight Control—Aer E 431</td>
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<td>Aerodynamic Theory I—Aer E 441</td>
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<tr>
<td>Aerospace Seminar—Aer E 491</td>
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Total: 16

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<tr>
<td>Aerospace technical electives</td>
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<tbody>
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<tr>
<td>Design and Analysis III—Aer E 463</td>
<td>3</td>
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<tr>
<td>Aerospace technical electives</td>
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</tr>
<tr>
<td>Elective***</td>
<td>3</td>
</tr>
<tr>
<td>Socio-humanistic elective</td>
<td>3</td>
</tr>
<tr>
<td>Aerospace Seminar—Aer E 493</td>
<td>R</td>
</tr>
</tbody>
</table>

Total: 16

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

**These technical electives are to be selected from the option sequences: Aerodynamics (Aer.E. 442, 443), Aeroelasticity (E.M. 444, Aer.E. 480), Flight Mechanics (Aer.E. 452, 453), Hydrospace (Aer.E. 455, 456), Pro-
Curriculum in Agricultural Engineering

With options in electric power and processing, farm power and machinery, structures and environment, and soil and water control. Administered jointly by the College of Agriculture and the College of Engineering.

Leading to the degree Bachelor of Science. Total credits required—199. Six months of practical work in agriculture or industry acceptable to this department is required before graduation.

See also Basic Program and Cooperative Programs.

SOPHOMORE YEAR

<table>
<thead>
<tr>
<th>Full</th>
<th>Credits</th>
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<tbody>
<tr>
<td>Agricultural Engineering Concepts I—A E 230</td>
<td>4</td>
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<tr>
<td>Materials and Processes—A E 259</td>
<td>3</td>
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<tr>
<td>Analytic Geometry and Calculus—Math 223 or 233</td>
<td>4-5</td>
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<tr>
<td>Introduction to Classical Physics—Phys 222</td>
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WINTER

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<thead>
<tr>
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<tbody>
<tr>
<td>Agricultural Engineering Concepts II—A E 231</td>
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<td>Elementary Differential Equations—Math 213</td>
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<tr>
<td>Introduction to Classical Physics—Phys 223</td>
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<tr>
<td>Socio-humanistic electives*</td>
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SPRING

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</thead>
<tbody>
<tr>
<td>Agricultural Engineering Concepts III—A E 232</td>
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<tr>
<td>Introduction to Applied Mathematics I—Math 321</td>
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<tr>
<td>Mechanics of Materials I—E M 325</td>
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<tr>
<td>Socio-humanistic electives*</td>
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<tr>
<td>Fundamentals of Botany—Bot 307</td>
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JUNIOR YEAR

<table>
<thead>
<tr>
<th>Full</th>
<th>Credits</th>
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<tbody>
<tr>
<td>Introduction to Circuits and Instruments—E E 441</td>
<td>4</td>
</tr>
<tr>
<td>Computer Programming—Com S 201</td>
<td>3</td>
</tr>
<tr>
<td>Materials Laboratory—E M 327</td>
<td>1</td>
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<tr>
<td>Principles of Economics—Econ 244</td>
<td>3</td>
</tr>
<tr>
<td>Mechanics of Materials II—E M 328</td>
<td>3</td>
</tr>
<tr>
<td>Option**</td>
<td>3</td>
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<tr>
<td>Seminar—A E 301</td>
<td>R</td>
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<td><strong>17</strong></td>
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<table>
<thead>
<tr>
<th>Winter</th>
<th>Credits</th>
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<tbody>
<tr>
<td>Thermodynamics I—M E 321</td>
<td>4</td>
</tr>
<tr>
<td>Principles of Economics—Econ 242</td>
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</tr>
<tr>
<td>Dynamics I—E M 345</td>
<td>3</td>
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<td>Option or agricultural engineering electives**</td>
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<td>Seminar—A E 302</td>
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<table>
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<tr>
<td>Electronic Circuits, Instruments and Systems—E E 445</td>
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<td>Fundamentals of Speech—Sp 211</td>
<td>3</td>
</tr>
<tr>
<td>Seminar—A E 303</td>
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<td><strong>17</strong></td>
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SENIOR YEAR

<table>
<thead>
<tr>
<th>Full</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>Mechanics of Fluids—E M 378</td>
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<tr>
<td>Option or agricultural engineering electives**</td>
<td>10</td>
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<tr>
<td>Socio-humanistic electives*</td>
<td>3</td>
</tr>
<tr>
<td>Seminar—A E 401</td>
<td>R</td>
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<td><strong>17</strong></td>
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<table>
<thead>
<tr>
<th>Winter</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Option or agricultural engineering electives**</td>
<td>10</td>
</tr>
<tr>
<td>Socio-humanistic electives*</td>
<td>3</td>
</tr>
<tr>
<td>Seminar—A E 402</td>
<td>R</td>
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<tr>
<td><strong>16</strong></td>
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<table>
<thead>
<tr>
<th>Spring</th>
<th>Credits</th>
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<tbody>
<tr>
<td>American Government—Pol S 215</td>
<td>3</td>
</tr>
<tr>
<td>Option or agricultural engineering electives**</td>
<td>10</td>
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<tr>
<td>Socio-humanistic electives*</td>
<td>3</td>
</tr>
<tr>
<td>Seminar—A E 403</td>
<td>R</td>
</tr>
<tr>
<td><strong>16</strong></td>
<td></td>
</tr>
</tbody>
</table>

*Socio-humanistic sequences are to be chosen from the department-approved list.

**In the junior and senior years, each student elects one of the options and takes the courses listed for the selected option. In addition, each student must select a minimum of 15 credits of agricultural engineering electives from the other three options. At least one course must be selected in each of the other three options. The list of agricultural engineering electives includes: 346, 377, 424, 425, 434, 437, 461, 484, 456, 471.

Options

| Electric Power and Processing—A E 461, 464, 465 | 5 |
| M E 325, 335, 336, 420, 421, 428 | 6 |
| E M 346 | 1 |
| Met 231 |
| Farm Power and Machinery—A E 434, 435, 436, 437 | 7 |
| M E 335, 336, 420, 421, 424 | 6 |
| E M 346 | 1 |
| Met 231 |
| Structures and Environment—A E 377, 471, 477 | 4 |
| C E 325, 331, 432, 434 | 5 |
| M E 325, 426 |
| Soil and Water Control—A E 434, 425 | 6 |
| C E 304, 331, 380, 361, 432, 434 | 8 |
| Stat 105 |

Curriculum in Architecture

This is a six-year academic program consisting of:

1. A four-year undergraduate program in architecture leading to the degree Bachelor of Arts, a nonprofessional degree.
2. A recommended year working in the profession.
3. A two-year graduate program leading to the degree Master of Architecture, a professional degree.

The four-year program in architecture is designed to prepare graduates to assume productive and responsible careers in businesses and industries related to architecture, and leads to the degree Bachelor of Arts, a nonprofessional degree. Elective opportunities are offered in group requirements. The student may choose a technical option of required courses. This option is provided to serve those students who may wish to pursue subsequent studies relevant to architecture in engineering or science. The total number of credits required for the degree Bachelor of Arts is 195.

Qualified students holding the degree Bachelor of Arts in architecture or its equivalent may be admitted to the two-year graduate program leading to the first professional degree, Master of Architecture. Students must be in the upper half of their class and receive the baccalaureate degree to be qualified to enter graduate study. For further information see Graduate College. This program is designed to educate professional architects to work effectively within contemporary constraints, to comprehend continuing changes within our society, and to formulate concepts of a better human environment.

The department offers a foreign studies program and students are encouraged to participate in it.

It is recommended that students holding the degree Bachelor of Arts in architecture and intending to pursue the degree Master of Architecture spend one year working in the profession before undertaking further architectural studies.

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

In addition, the department offers a one-year graduate program for students who have already received the professional degree in architecture. See the Graduate Catalog or the courses and programs section of this catalog.

Undergraduate Program in Architecture*

Preparatory Courses

<table>
<thead>
<tr>
<th>Course Description</th>
<th>Credits</th>
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<tbody>
<tr>
<td>Language in Composition and Reading—Engl 104, 105</td>
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</tr>
<tr>
<td>Library Instruction—Lib 160</td>
<td></td>
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<tr>
<td>Analytic Geometry and Calculus—Math 120, 121, 122</td>
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<tr>
<td>General Physics—Phys 111, 112</td>
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<tr>
<td>History of Western Civilization—Hist 201, 202, 203</td>
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Professional Courses

<table>
<thead>
<tr>
<th>Course Description</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>Orientation—Arch 101</td>
<td>3</td>
</tr>
<tr>
<td>Architectural Graphics—E Gr 241, 242, 243</td>
<td>9</td>
</tr>
<tr>
<td>Freehand Drawing—Arch 234, 236, 238</td>
<td>8</td>
</tr>
<tr>
<td>Design—Arch 211, 212</td>
<td>10</td>
</tr>
<tr>
<td>Scalar Statics—E M 276</td>
<td>3</td>
</tr>
<tr>
<td>Systems of Visual Order—Arch 300</td>
<td>3</td>
</tr>
<tr>
<td>Design—Arch 311, 312</td>
<td>10</td>
</tr>
<tr>
<td>History of Architecture I—Arch 321, 322, 323</td>
<td>9</td>
</tr>
<tr>
<td>Architectural Technologies I—Arch 341, 342, 343</td>
<td>9</td>
</tr>
<tr>
<td>Mechanics of Materials—E M 325</td>
<td>3</td>
</tr>
<tr>
<td>Analysis of Statical Determinate Structures—C E 331A</td>
<td>3</td>
</tr>
<tr>
<td>Design—Arch 411, 412</td>
<td>10</td>
</tr>
<tr>
<td>History of Architecture II—Arch 421, 422, 423</td>
<td>9</td>
</tr>
<tr>
<td>Architectural Technologies II—Arch 444, 446, 447</td>
<td>9</td>
</tr>
<tr>
<td>Analysis of Statical Indeterminate Structures—C E 432A</td>
<td>4</td>
</tr>
<tr>
<td>Structural Steel Design—C E 433A</td>
<td>4</td>
</tr>
<tr>
<td>Reinforced Concrete Design—C E 434A</td>
<td>4</td>
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<tr>
<td>Electives</td>
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</tr>
<tr>
<td>Group I—Basic social sciences</td>
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</tr>
<tr>
<td>Group II—Unrestricted electives</td>
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Undergraduate Program in Architecture, Technical Option*

Preparatory Courses

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<tr>
<td>Language in Composition and Reading—Engl 104, 105</td>
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</tr>
<tr>
<td>Library Instruction—Lib 160</td>
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</tr>
<tr>
<td>Analytic Geometry and Calculus—Math 120, 121, 122</td>
<td>19</td>
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<tr>
<td>Elementary Differential Equations—Math 213</td>
<td>3</td>
</tr>
<tr>
<td>Introduction to Classical Physics—Phys 221, 222</td>
<td>10</td>
</tr>
<tr>
<td>History of Western Civilization—Hist 201, 202, 203</td>
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Professional Courses

<table>
<thead>
<tr>
<th>Course Description</th>
<th>Credits</th>
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<tbody>
<tr>
<td>Orientation—Arch 101</td>
<td>3</td>
</tr>
<tr>
<td>Architectural Graphics—E Gr 241, 242, 243</td>
<td>9</td>
</tr>
<tr>
<td>Freehand Drawing—Arch 234, 236, 238</td>
<td>8</td>
</tr>
<tr>
<td>Design—Arch 211, 212</td>
<td>10</td>
</tr>
<tr>
<td>Statics of Engineering—E M 274</td>
<td>3</td>
</tr>
<tr>
<td>Systems of Visual Order—Arch 300</td>
<td>3</td>
</tr>
<tr>
<td>Design—Arch 311, 312</td>
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<tr>
<td>History of Architecture I—Arch 321, 322, 323</td>
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</tr>
<tr>
<td>Architectural Technologies I—Arch 341, 342, 343</td>
<td>9</td>
</tr>
<tr>
<td>Mechanics of Materials—E M 325</td>
<td>3</td>
</tr>
<tr>
<td>Analysis of Statical Determinate Structures—C E 331A</td>
<td>3</td>
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<tr>
<td>Design—Arch 411, 412</td>
<td>10</td>
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<tr>
<td>History of Architecture II—Arch 421, 422, 423</td>
<td>9</td>
</tr>
<tr>
<td>Architectural Technologies II—Arch 444, 446, 447</td>
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<tr>
<td>Analysis of Statical Indeterminate Structures—C E 432A</td>
<td>4</td>
</tr>
<tr>
<td>Structural Steel Design—C E 433A</td>
<td>4</td>
</tr>
<tr>
<td>Reinforced Concrete Design—C E 434A</td>
<td>4</td>
</tr>
<tr>
<td>Electives</td>
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</tr>
<tr>
<td>Group I—Basic social sciences</td>
<td>9</td>
</tr>
<tr>
<td>Group II—Unrestricted electives</td>
<td>24</td>
</tr>
</tbody>
</table>

*For assistance in planning course sequences and a course schedule, fulfilling the specific prerequisites, the student is advised to acquire a flow diagram from the department office.

Elective Courses: A minimum of 18 credits of the total electives must be taken outside of the departments of Applied Art, Architecture and Landscape Architecture, and the Design Center.

Group I—Basic social sciences. Courses in the following departments of the university: Psychology, Sociology, Economics, Anthropology, and Political Science.

Group II—Unrestricted electives. Students are encouraged to plan with the approval of their advisors a group of
electives which will assist the development of professional study. Additional credits in the departments listed under Group I may be included. A maximum of 3 credits of physical education may also be included. Prerequisites for undergraduate and for graduate courses should be investigated.

Summary of Credits:

<table>
<thead>
<tr>
<th></th>
<th>Undergraduate Program</th>
<th>Preparatory and professional courses</th>
<th>151</th>
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<tbody>
<tr>
<td></td>
<td>Electives: Group I</td>
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<td>9</td>
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<tr>
<td></td>
<td>Group II</td>
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<table>
<thead>
<tr>
<th></th>
<th>Undergraduate Program, Technical Option</th>
<th>Preparatory and professional courses</th>
<th>162</th>
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<tbody>
<tr>
<td></td>
<td>Electives: Group I</td>
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<td>9</td>
</tr>
<tr>
<td></td>
<td>Group II</td>
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GRADUATE PROGRAM IN ARCHITECTURE. Minimum requirements.

For students with the degree Bachelor of Arts in architecture:
- Seminar—Arch 501……………………………….2
- Research and Design—Arch 514A……………………2
- Seminar—Arch 603;
- Research and/or Design—Arch 616……………………54
- Supporting course work…………………………30
- Total credits…………………………………..90

For students with the professional degree Bachelor of Architecture:
- Seminar—Arch 501……………………………….2
- Research and Design—Arch 514B……………………4
- Seminar—Arch 603;
- Research and/or Design—Arch 616…………………24
- Supporting course work…………………………16
- Total credits…………………………………..45

Curriculum in Ceramic Engineering

Leading to the degree Bachelor of Science. Total credits required—186. See also Basic Program.

Professional Program

SOPHOMORE YEAR

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JUNIOR YEAR

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<td>DC and AC Circuits and Machines—E E 341</td>
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SENIOR YEAR

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*Socio-humanistic electives must be department approved.
Curriculum in Chemical Engineering

Leading to the degrees Bachelor of Science and Master of Engineering. Total credits required—Bachelor of Science: 185; Master of Engineering: 235. See also Basic Program and Cooperative Programs.

### Second Year

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### Third Year

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### Fifth Year***

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### Practice Option

Leading to degree Bachelor of Science. Total credits required—187.

**Second Year**

Same as above.

**Third Year**

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**Winter**

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**Spring**

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**Curriculum in Civil Engineering**

Leading to the degree Bachelor of Science. Total credits required—194.

See also Basic Program and Cooperative Programs.

For those interested in construction engineering a curriculum is provided which leads to the degree Bachelor of Science in construction engineering. For particulars, consult the professor in charge, construction engineering curriculum. See Construction Engineering, Courses and Programs.
Curriculum in Chemical Engineering

Leading to the degrees Bachelor of Science and Master of Engineering. Total credits required—Bachelor of Science: 183; Master of Engineering: 235. See also Basic Program and Cooperative Programs.

Second Year

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Fifth Year***

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<td>Individual Problems—Ch E 500</td>
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Practice Option

Leading to degree Bachelor of Science. Total credits required—187.

Second Year

Same as above.

Third Year

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<td>Physical Chemistry—Chem 322</td>
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<td>Principles of Mechanics—E M 301</td>
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<td>Momentum Transport Operations—Ch E 352</td>
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<tr>
<td>Chemical Engineering Thermodynamics—Ch E 461</td>
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<td>Principles of Mechanics—E M 302</td>
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<td><strong>Spring</strong></td>
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<tr>
<td>Technical Seminar—Ch E 401</td>
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<tr>
<td>Chemical Reactor Design—Ch E 463</td>
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<td>Mass Transport Operations—Ch E 454</td>
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<td>Chemical Engineering Laboratory—Ch E 451</td>
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<tr>
<td>Writing of Reports and Technical Papers—Engi 414</td>
<td>3</td>
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<tr>
<td>Modern Physics—Phys 301</td>
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<td>Socio-humanistic elective*</td>
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Spring
Junior Inspection Trip—Ch E 300 ........................................... R
Energy Transport Operations—Ch E 353 ................................. 3
Computer Applications in Chemical Engineering—
  Ch E 341 ........................................................................ 3
Chemical Engineering Thermodynamics—Ch E 462 ................. 3
DC and AC Circuits and Machines—E E 341 ............................... 4
Socio-humanistic elective* .................................................. 3

Credit Total 16

Fall
Technical Seminar—Ch E 401 .................................................. R
Chemical Reactor Design—Ch E 463 ........................................ 3
Mass Transport Operations—Ch E 454 ....................................... 3
Chemical Engineering Laboratory—Ch E 451 .............................. 2
Chemical Engineering Design—Ch E 471A ................................. 3
Writing of Reports and Technical Papers—Engl 414 .................... 3
Socio-humanistic elective* .................................................. 3

Credit Total 17

Winter
Technical Seminar—Ch E 402 .................................................. R
Process Control—Ch E 435 ..................................................... 3
Process Control Laboratory—Ch E 450 ....................................... 2
Chemical Engineering Design—Ch E 472A ................................. 3
Business elective *** ......................................................... 3
Socio-humanistic elective* .................................................. 3
Elective .............................................................................. 3

Credit Total 17

Spring
Technical Seminar—Ch E 403 .................................................. R
Chemical Engineering Laboratory—Ch E 452 .............................. 2
Chemical Engineering Design—Ch E 473A ................................. 3
Socio-humanistic elective* .................................................. 3
Elective .............................................................................. 3
Business elective +++ ......................................................... 3

Credit Total 17

*Selected from list of department-approved sequences.
**For graduate credit; not required for B.S. degree.
+++Leading to Master of Engineering; subject to approval of advisory committee and admission to graduate college.

Curriculum in Civil Engineering

Leading to the degree Bachelor of Science. Total credits required—194.

See also Basic Program and Cooperative Programs.

For those interested in construction engineering a curriculum is provided which leads to the degree Bachelor of Science in construction engineering. For particulars, consult the professor in charge, construction engineering curriculum. See Construction Engineering, Courses and Programs.

SOPHOMORE YEAR

Fall
Analytic Geometry and Calculus III—Math 223 or
  233 .......... ................................................................. 4 or 5
Introduction to Classical Physics—Phys 222 ......................... 5
Elementary Surveying—C E 211 ........................................... 3
Computer Programming—Com S 201 .................................... 3
Professional Development—C E 294 ................................... R

Credit Total 15-16

Winter
Elementary Differential Equations—Math 213 ....................... 3
Introduction to Classical Physics—Phys 223 ......................... 5
Photogrammetry, Mapping, and Land Surveying—
  C E 212 ................................................................. 3
Statics of Engineering—E M 274 ........................................... 3
Socio-humanistic elective* .................................................. 3

Credit Total 17

Spring
Strength of Materials—E M 324 .......................................... 6
Engineering Materials—E M 354 ........................................... 3
Route and Higher Surveying—C E 213 ................................. 3
Geology for Engineers—Geol 301 ......................................... 3
Socio-humanistic elective* .................................................. 3

Credit Total 17

JUNIOR YEAR

Fall
Dynamics I—E M 345 .......................................................... 3
Analysis of Statically Indeterminate Structures—C E 331 ........ 3
Soil Engineering—C E 360 .................................................. 3
Basic science elective* ....................................................... 3
Socio-humanistic elective* .................................................. 3

Credit Total 15

Winter
Mechanics of Fluids—E M 378 .............................................. 4
Materials Laboratory—E M 327 ............................................. 1
Soil and Aggregate Materials Laboratory—C E 361 ............... 3
Water and Wastewater Treatment—G E 325 ....................... 3
Analysis of Statically Indeterminate Structures—
  C E 432 ................................................................. 4
Planning of Transportation Facilities—C E 352 ................. 3
Professional Development—C E 355 ................................... R

Credit Total 18

Spring
Engineering Construction—C E 485 ................................. 3
Hydrology—C E 304 .......................................................... 3
Design of Concretes and Stabilized Soil Systems—
  C E 362 ................................................................. 3
Analysis for Engineering Economy—I E 304 ....................... 3
Structural Steel Design I—C E 343 ....................................... 3
Socio-humanistic elective* .................................................. 3

Credit Total 18

SENIOR YEAR

Fall
Design of Water Supply and Sewer Systems—C E 426 ........ 4
Design of Transportation Facilities—C E 453 ................. 4
Reinforced Concrete Design I—C E 454 ................................. 3
Electives* ..................................................................... 3
Professional Development—C E 496 ................................... R

Credit Total 17

Winter
Writing of Reports and Technical Papers—Engl 414 ............ 3
Electives* ..................................................................... 12

Credit Total 15
### SOPHOMORE YEAR

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<tr>
<td>Analysis of Materials and Methods of Construction—Con E 241</td>
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<tr>
<td>Analytic Geometry and Calculus III—Math 223 or 238</td>
<td>4 or 5</td>
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<tr>
<td>Introduction to Classical Physics—Phys 222</td>
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<td>Elementary Surveying—C E 211</td>
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<td>15-16</td>
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<td>Winter</td>
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<tr>
<td>Construction Specifications—Con E 245</td>
<td>3</td>
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<tr>
<td>Introduction to Classical Physics—Phys 223</td>
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<td>Statics of Engineering—E M 274</td>
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<td>Introduction to Statistics—Stat 105</td>
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### JUNIOR YEAR

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<tr>
<td>Construction Cost Estimating—Con E 246</td>
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<td>Geology for Engineers—Geo 301</td>
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<td>Strength of Materials—E M 324</td>
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<td>Computer Programming—Com S 201</td>
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<tr>
<td>Business Law I—I Ad 365A* (3 cr.) or Route and Higher Surveying—C E 213** (3 cr.)</td>
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### SENIOR YEAR

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<thead>
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<tr>
<td>Concrete Construction and Formwork Design—Con E 440</td>
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<td>Reinforced Concrete Design I—C E 434</td>
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<td>Computer-Oriented Business Data Systems I—Com S 441</td>
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<td>Seminar—Con E 400</td>
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### Winter

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<tr>
<td>Construction Progress Scheduling II—Con E 441</td>
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<tr>
<td>Business and Professional Speaking—Sp 312</td>
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### Spring

<table>
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<tr>
<td>Special Problems in Construction Engineering—Con E 490</td>
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<td>Writing of Reports and Technical Papers—Engl 414</td>
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</table>

*For students emphasizing building construction.
**For students emphasizing heavy construction.
***Electives to include (minimum):
  - nine credits socio-humanities.
  - nine credits basic sciences and engineering sciences (at least six credits in engineering science).
  - twelve credits technical or business and management (at least three credits in business and management).

For students emphasizing building construction, the following courses must be included within the electives: M E 406, 407, Arch 444, and a course in fluid mechanics.

For students emphasizing heavy construction the following courses must be included within the electives: C E 304, 362.

Students emphasizing mechanical construction should consult with the professor in charge of construction engineering regarding course requirements.
## Curriculum in Electrical Engineering

Leading to the degree Bachelor of Science. Total credits required—193.

See also Basic Program and Cooperative Programs.

### SOPHOMORE YEAR

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<td>E 205</td>
<td>Basic Electric Circuits I</td>
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<td>Phys 223</td>
<td>Analytic Geometry and Calculus</td>
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<td>Math 223 or 233</td>
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<td>Winter</td>
<td>E 206</td>
<td>Basic Electric Circuits II</td>
<td>3</td>
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<td>E 313</td>
<td>Electric Instrumentation and Experimentation I</td>
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<td>M 301</td>
<td>Statistics of Engineering</td>
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<td>S 201</td>
<td>Computer Programming</td>
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<td>E 374</td>
<td>Electronics Engineering</td>
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<td>E 323</td>
<td>Electrical Instrumentation and Experimentation II</td>
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<td>E 314</td>
<td>Introduction to Electromagnetic Fields I</td>
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<td>M 345**</td>
<td>Particle Dynamics</td>
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### JUNIOR YEAR

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<td>Electronics Engineering</td>
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<td>E 308</td>
<td>Electric Circuit Analysis and Design I</td>
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<td>Math 321</td>
<td>Introduction to Applied Mathematics I</td>
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<td>Phys 302</td>
<td>Modern Physics</td>
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<td>Elementary Power Circuits and Magnetic Devices</td>
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<tr>
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<td>Phys 303</td>
<td>Modern Physics</td>
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<td>Introduction to Numerical Techniques for Computers</td>
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<td>E 351</td>
<td>Electric Machinery</td>
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### SENIOR YEAR

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</table>

**These electives are to be chosen from the department-approved list of socio-humanistic sequences.**

**The sequence E M 301 and 302 may be elected in place of the sequence E M 274 and 345.**

***The only restriction on these electives is that they cannot be remedial courses.***

All students must take at least 22 credits of electrical engineering technical electives. The list below is recommended. E E 500-level courses may also be elected by qualified undergraduates. Students who plan to enter graduate school and major in electrical engineering should take seven 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: 404, 410, 411, 412, 420, 421, 425, 426, 427, 428, 431, 436, 460, 468, 467, 475, 605, 627.

## Curriculum in Engineering Operations

Administered by the Department of Industrial Engineering.

Leading to the degree Bachelor of Science. Total credits required—180. See also Cooperative Programs.

The curriculum consists of a basic core of required courses in the sciences, engineering, and management to which are added 95 credits of elective courses in the specific categories of engineering, socio-humanistics, management, and preliminary supporting subjects. Within this framework, students may specialize toward specific occupational objectives of their choice. Many students choose to work toward the specializations indicated below.

### Specializations

**Production Management—Emphasis on direction of all phases of the production process.**

**Manufacturing Processes—Emphasis on production considerations in selection and specification of manu-**
facturing equipment. Functional characteristics of equipment related to production.

Technical Sales—Provides a background for selling products of a technical nature.

Prelaw—Preparation for graduate work in corporate or patent law.

Operations Research—Development of mathematical concepts and models concerned with decision making in engineering and management.

Special Programs

To meet special needs, programs are available in the following (See Index):

Program in International Studies.
Program in Engineering Journalism.
Program in Engineering for Officer Education.
Program in Surveying and Mapping.

Required Courses

Basic Sciences
Math 120, 121, 122, 223; or 130, 131, 132, 233 ....... 19
Chem 141, 141L, 142, 142L ....... 16
Phys 221, 222, 223 ....... 16

Socio-humanistic courses
Psych 101 ....... 3
Econ 241, 242 ....... 6
Pol S 215 ....... 3

Communication Skills
E Gr 161, 162 ....... 6
Engl 104, 105 ....... 8
Sp 211, Engl 414 ....... 6

Miscellaneous
IE 108, Lib 160 ....... 2
IE 460 or 1 Ad 365A ....... 3
Com S 201, 1 Ad 371 ....... 6
Engr 114 and department seminar 109 ....... R
IE 293, 393 ....... R

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.

Curriculum in Engineering Science

Administered by the Department of Engineering Science and Mechanics.

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

See also Basic Program and Cooperative Programs

SOPHOMORE YEAR

Fall
Analytic Geometry and Calculus—Math 223 or 233 ....... 4-5
Introduction to Classical Physics—Phys 223 ....... 5
Foreign language ....... 4

Winter
Elementary Differential Equations—Math 213 ....... 3
Energy Sources and Utilization—E Sci 211 ....... 3
Foreign language ....... 4

JUNIOR YEAR

Fall
Introduction to Applied Mathematics I—Math 322 ....... 3
Engineering Materials—E Sci 351 ....... 4
Modern Physics—Phys 301 ....... 3
Foreign language ....... 3

Winter
Introduction to Circuits and Instruments—E E 441 ....... 4
Engineering Materials—E Sci 352 ....... 4
Modern Physics—Phys 302 ....... 3
Foreign language ....... 3

SENIOR YEAR

Fall
Engineering Analysis—E Sci 451 ....... 4
Electronic Circuits Instruments, and Systems—E E 445 ....... 4
Mass Transport Operations—Chem E 454 ....... 3
Socio-humanistic elective* ....... 3

Credits

Minimum

Fall
Introduction to Applied Mathematics I—Math 322 ....... 3
Dynamics I—E M 345 ....... 3
Engineering Materials—E Sci 351 ....... 4
Modern Physics—Phys 301 ....... 3
Socio-humanistic elective* ....... 3

Winter
Introduction to Circuits and Instruments—E E 441 ....... 4
Mechanics of Fluids—E M 378 ....... 4
Engineering Materials—E Sci 352 ....... 4
Modern Physics—Phys 302 ....... 3
Socio-humanistic elective* ....... 3

Spring
Electronic Circuits Instruments, and Systems—E E 445 ....... 4
Energy Transport Operations—Chem E 359 ....... 3
Engineering Materials—E Sci 353 ....... 4
Modern Physics—Phys 303 ....... 3
Socio-humanistic elective* ....... 3

Credits

Fall
Engineering Analysis—E Sci 451 ....... 4
Electronic Circuits Instruments, and Systems—E E 445 ....... 4
Mass Transport Operations—Chem E 454 ....... 3
Socio-humanistic elective* ....... 3
Elective** ....... 3

Credits
Curriculum in Industrial Engineering

Leading to the degree Bachelor of Science. Total credits required—193.

See also Basic Program and Cooperative Programs.

SOPHOMORE YEAR

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<tr>
<td>Analytic Geometry and Calculus—Math 223 or 233</td>
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<td>Metallurgy for Engineers—Met 231</td>
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<td>Introduction to Industrial Engineering—I E 250</td>
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<td>Introduction to Classical Physics—Phys 222</td>
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<td>Elementary Differential Equations—Math 213</td>
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<td>Fundamentals of Speech—Sp 211</td>
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<td>Principles of Economics—Econ 241</td>
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<td>Introduction to Classical Physics—Phys 223</td>
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16-17

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<td>Linear Algebra—Math 205</td>
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<td>Methods Engineering and Work Measurement—I E 273</td>
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<td>Statics of Engineering—E M 274</td>
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<td>Principles of Economics—Econ 242</td>
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<td>American Government—Pol S 215</td>
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<td>Seminar—I E 293</td>
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16

JUNIOR YEAR

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<td>Introduction to Theory of Probability and Statistics—Stat 341</td>
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<td>Engineering mechanics elective*</td>
<td>3</td>
</tr>
<tr>
<td>Engineering science elective*</td>
<td>3</td>
</tr>
<tr>
<td>Elective**</td>
<td>3</td>
</tr>
<tr>
<td>Winter</td>
<td></td>
</tr>
<tr>
<td>Introduction to Theory of Probability and Statistics—Stat 342</td>
<td>3</td>
</tr>
<tr>
<td>Industrial Operations Research—I E 312</td>
<td>4</td>
</tr>
<tr>
<td>Engineering mechanics elective*</td>
<td>3</td>
</tr>
<tr>
<td>Engineering science elective*</td>
<td>3</td>
</tr>
<tr>
<td>Socio-humanistic elective*</td>
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</tr>
<tr>
<td>Seminar—I E 392</td>
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</table>

16

<table>
<thead>
<tr>
<th>Semester</th>
<th>Credits</th>
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<tbody>
<tr>
<td>Spring</td>
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<tr>
<td>Quantitative Methods for Industrial Engineering—I E 381</td>
<td>3</td>
</tr>
<tr>
<td>Industrial Operations Research—I E 313</td>
<td>3</td>
</tr>
<tr>
<td>Engineering Unit Operations—Chem E 310</td>
<td>4</td>
</tr>
<tr>
<td>Engineering Economy—I E 404</td>
<td>4</td>
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<tr>
<td>Engineering science elective*</td>
<td>3</td>
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<tr>
<td>Industrial Inspection Trip—I E 393</td>
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</table>

17

SENIOR YEAR

<table>
<thead>
<tr>
<th>Semester</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>Fall</td>
<td></td>
</tr>
<tr>
<td>Industrial Engineering Design I—I E 441</td>
<td>5</td>
</tr>
<tr>
<td>Manpower Management—I E 424</td>
<td>3</td>
</tr>
<tr>
<td>Thermodynamics—I—M E 321 or Thermodynamics—Phys 304</td>
<td>3</td>
</tr>
<tr>
<td>Writing of Reports and Technical Papers—Engl 414</td>
<td>3</td>
</tr>
<tr>
<td>Socio-humanistic elective*</td>
<td>3</td>
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<tr>
<td>Seminar—I E 491</td>
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</tbody>
</table>

17

<table>
<thead>
<tr>
<th>Semester</th>
<th>Credits</th>
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<tbody>
<tr>
<td>Winter</td>
<td></td>
</tr>
<tr>
<td>Industrial Engineering Design II—I E 442</td>
<td>6</td>
</tr>
<tr>
<td>Industrial engineering elective**</td>
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<td>Socio-humanistic elective*</td>
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</tbody>
</table>

15

<table>
<thead>
<tr>
<th>Semester</th>
<th>Credits</th>
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<tbody>
<tr>
<td>Spring</td>
<td></td>
</tr>
<tr>
<td>Industrial Engineering Electives**</td>
<td>6</td>
</tr>
<tr>
<td>Electronic Circuits, Instruments and Systems—E E 445</td>
<td>4</td>
</tr>
<tr>
<td>Elective</td>
<td>3</td>
</tr>
<tr>
<td>Socio-humanistic elective*</td>
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</tbody>
</table>

16

**These electives are to be chosen as sequences with advance approval from department-authorized lists.

* Industrial engineering electives are to be chosen from the following: 407, 416, 420, 421, 423, 425, 428, 443, 446, 461, 462, 463.

This elective may be from the socio-humanistic, the industrial engineering, or the supporting elective list.
Curriculum in Mechanical Engineering

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

See also Basic Program and Cooperative Programs.

SOPHOMORE YEAR

<table>
<thead>
<tr>
<th>Fall</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>Analytic Geometry and Calculus—Math 223 or 233</td>
<td>4-5</td>
</tr>
<tr>
<td>Introduction to Classical Physics—Phys 223</td>
<td>5</td>
</tr>
<tr>
<td>Introduction to Mechanical Engineering I—M E 251</td>
<td>4</td>
</tr>
<tr>
<td>Socio-humanistic elective*</td>
<td>3</td>
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<tr>
<td></td>
<td>16-17</td>
</tr>
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Winter

<table>
<thead>
<tr>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
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Spring

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<tr>
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JUNIOR YEAR

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>Fundamentals of Speech**—Sp 211</td>
<td>3</td>
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<tr>
<td>Mechanical Behavior of Materials—M E 331</td>
<td>4</td>
</tr>
<tr>
<td>Mechanics of Materials II—E M 326</td>
<td>3</td>
</tr>
<tr>
<td>Dynamics I—E M 346</td>
<td>3</td>
</tr>
<tr>
<td>Thermodynamics I—M E 321</td>
<td>4</td>
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Winter

<table>
<thead>
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<th>Credits</th>
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<tbody>
<tr>
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Spring

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<tbody>
<tr>
<td>4</td>
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SENIOR YEAR

<table>
<thead>
<tr>
<th>Fall</th>
<th>Credits</th>
</tr>
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<tbody>
<tr>
<td>Machine Design II—M E 421</td>
<td>3</td>
</tr>
<tr>
<td>Engineering Measurements I—M E 481</td>
<td>3</td>
</tr>
<tr>
<td>Fluid Flow and Heat Transfer—M E 425</td>
<td>4</td>
</tr>
<tr>
<td>Thermodynamics IV—M E 324</td>
<td>4</td>
</tr>
<tr>
<td>Socio-humanistic elective*</td>
<td>3</td>
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<tr>
<td>Professional Conduct—M E 400</td>
<td>R</td>
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<tr>
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Winter

<table>
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</table>

Curriculum in Metallurgical Engineering

Leading to the degree Bachelor of Science. Total credits required—190.

See also Basic Program.

SOPHOMORE YEAR

<table>
<thead>
<tr>
<th>Fall</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>Principles of Materials Science—Met 230</td>
<td>4</td>
</tr>
<tr>
<td>Analytic Geometry and Calculus—Math 223 or 233</td>
<td>4-6</td>
</tr>
<tr>
<td>Introduction to Classical Physics—Phys 222</td>
<td>5</td>
</tr>
<tr>
<td>Socio-humanistic elective*</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>16-17</td>
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</tbody>
</table>

Winter

<table>
<thead>
<tr>
<th>Credits</th>
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<tr>
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Spring

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<th>Credits</th>
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<td>3</td>
</tr>
</tbody>
</table>

*Socio-humanistic electives must include two 6-credit sequences involving social organization and human values; they are to be selected from a department-approved list.

**Not required of students completing advanced ROTC programs. Consult adviser.

***Technical electives must include at least nine credits of mechanical engineering courses chosen from 400- and 500-level offerings. Additional electives may be chosen from the offerings of other engineering departments, mathematics, physical and biological sciences listed under "Open for graduate students for minor credit only" declaration of the departments, with one prerequisite course not on the list allowed.
College of Home Economics

The curricula of the College of Home Economics provide for the general or liberal education of the student as a person, a citizen, and family member, and for the education of the student for a variety of professional opportunities.

Qualified professional graduates are needed in the field of education as teachers of young children, teachers of home economics in secondary schools and colleges, teachers of physical education for women, and extension home economists. In the food field, opportunities exist for dietitians, food service directors, and school lunch supervisors. Food-processing, textile, and equipment companies employ home economists, as do retail clothing and home furnishing stores. Home economists are in positions on the editorial staffs of magazines and newspapers, in recreation programs for children, and in social helping services. Research at universities, with commercial organizations, and with the federal government offers numerous opportunities.

Faculty Adviser System

Each student in the College of Home Economics has a faculty adviser. A selected group of faculty serves as advisers to freshmen. Upperclass students are assigned faculty advisers in the departments of their chosen curriculum.

Curricula in Home Economics

Curricula in Home Economics and the majors provided in each are:

- Applied Art—advertising design; art education; craft design; interior design.
- Child Development—child development.
- Family Environment—family environment.
- Food and Nutrition—community nutrition; dietetics; food science; food and nutrition and related science.
Home Economics Education—home economics education.

Home Economics—international studies.

Home Economics Journalism—home economics journalism.

Institution Management—college food and housing administration; hotel and restaurant management; school food service.

Physical Education for Women—physical education for women.

Textiles and Clothing—textiles and clothing; textiles and clothing and related science.

Cooperative Program

The College of Home Economics has cooperative programs with Morningside and Central colleges. A student may take two years at either of these liberal arts colleges and two years at Iowa State University without the usual formalities of transferring. A special grouping of courses is provided which makes it possible for a student to pursue any of the curricula offered by the College of Home Economics.

Applications for admission to the cooperative program in home economics should be addressed to the director of admissions of Morningside or Central College.

The Core Curriculum

The educational foundation of students in the College of Home Economics is provided through the election of selected courses within specified areas identified as the core curriculum. All students in the College of Home Economics must complete the minimum specified credits in the core curriculum, except those who choose a major in related science combined with food and nutrition or textiles and clothing, and those who choose the curriculum in physical education for women.

Core requirements are in subject areas both within and outside the College of Home Economics. The possible choices for meeting the requirements are specified by departments and are incorporated in the listings of curricula by departments, which appear on the following pages.

Subject areas within the College of Home Economics are: applied art, textiles and clothing, (3 cr.); equipment and housing, (3 cr.); family and child, (3 cr.); management, (3 cr.); nutrition, (3 cr.); professional relations (R); physical education (3 cr.).

Subject areas outside the College of Home Economics are: biological sciences (8 cr.); physical sciences, mathematics, statistics (8 cr.); social sciences (15 cr.); humanities (15 cr.); library, Lib. 160 (1 cr.); written and spoken English (11 cr.).

Library instruction is to be completed in the first year of registration.

Students may prepare for work in the extension service by enrolling in any of the home economics curricula. Courses should include Psych. 333; Educ. 305, 468. Advice on choice of additional courses should be sought from the state leader of home economics extension program, one of the district leaders of home economics programs, or the coordinator of extension personnel training.

Home Economics and Related Science

Related science programs are available in the departments of Food and Nutrition and Textiles and Clothing. These programs provide a background for graduate study basic to professional advancement in the specified fields. Students who have completed one of these majors have found opportunities in research in medical laboratories, universities, foundations, industry, and government. Upon completion of a graduate degree, students are qualified for more responsible positions in these areas and for college and university teaching.

Curriculum in Applied Art

Leading to the degree Bachelor of Arts. Total credits required—195. Majors are offered in advertising design, art education, craft design, and interior design.

Core Curriculum Requirements

<table>
<thead>
<tr>
<th>Home Economics</th>
<th>Total credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Education</td>
<td>16</td>
</tr>
<tr>
<td>Applied art, textiles and clothing—AA 103</td>
<td>4</td>
</tr>
<tr>
<td>Equipment and housing—Select from FE 240, 254, 308, 318, 412</td>
<td>3</td>
</tr>
<tr>
<td>Family and the child—Select from CD 129, 228, FE 185, 285</td>
<td>3</td>
</tr>
<tr>
<td>Management—Select from FE 341, 488</td>
<td>3</td>
</tr>
<tr>
<td>Nutrition—Select from F &amp; N 107, 232</td>
<td>3</td>
</tr>
<tr>
<td>Professional Relations—H Ec 400</td>
<td>3</td>
</tr>
<tr>
<td>Biological sciences—Total credits 8</td>
<td></td>
</tr>
<tr>
<td>Principles of Biology—Blol 101</td>
<td>3</td>
</tr>
<tr>
<td>Select from Biol 101 B or Zoöl 158</td>
<td>3</td>
</tr>
<tr>
<td>Select from bacteriology, biology, botany, genetics, zoology</td>
<td>2</td>
</tr>
<tr>
<td>Physical sciences, mathematics, and statistics—Total credits 8</td>
<td></td>
</tr>
<tr>
<td>Select from chemistry, geology, mathematics, meteorology, physics</td>
<td>8</td>
</tr>
<tr>
<td>Social sciences—Total credits 15</td>
<td></td>
</tr>
<tr>
<td>American Government—Pol S 215</td>
<td>3</td>
</tr>
<tr>
<td>General Psychology—Psych 101</td>
<td>3</td>
</tr>
<tr>
<td>Introduction to Sociology—Soc 134</td>
<td>3</td>
</tr>
<tr>
<td>Select from anthropology, economics, political science, psychology, sociology</td>
<td>6</td>
</tr>
<tr>
<td>Humanities—Total credits 15</td>
<td></td>
</tr>
<tr>
<td>Western Civilization—Hist 201, 202</td>
<td>6</td>
</tr>
<tr>
<td>Select from foreign language, history, literature, music, philosophy</td>
<td>9</td>
</tr>
</tbody>
</table>
Major in Advertising Design

This major prepares students for positions in graphic design. In addition to the core curriculum requirements, the following courses are to be completed:

<table>
<thead>
<tr>
<th>Course</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Applied Art—A A 104</td>
<td>3</td>
</tr>
<tr>
<td>Drawing—A A 150</td>
<td>3</td>
</tr>
<tr>
<td>Lettering—A A 170</td>
<td>3</td>
</tr>
<tr>
<td>Color—A A 203</td>
<td>3</td>
</tr>
<tr>
<td>Water Based Media—A A 233</td>
<td>3</td>
</tr>
<tr>
<td>Intermediate Drawing—A A 250</td>
<td>3</td>
</tr>
<tr>
<td>Typography—A A 272</td>
<td>3</td>
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<tr>
<td>History of Art—A A 301, 302, 303</td>
<td>9</td>
</tr>
<tr>
<td>Painting—A A 333</td>
<td>3</td>
</tr>
<tr>
<td>Applied Textile Design—A A 347</td>
<td>3</td>
</tr>
<tr>
<td>Life Drawing—A A 350</td>
<td>3</td>
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<tr>
<td>Advertising Design—A A 370, 371</td>
<td>6</td>
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<tr>
<td>Graph Art Production—A A 373</td>
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<tr>
<td>Illustration for Advertising—A A 474</td>
<td>3</td>
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<tr>
<td>Technical Drawing for Applied Art—E Gr 121</td>
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</tr>
<tr>
<td>Journalism and Mass Communication</td>
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<tr>
<td>Publicity and Public Relations—Jl 225</td>
<td>3</td>
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<tr>
<td>Fundamentals of Photography</td>
<td>6</td>
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<tr>
<td>Advertising—Jl 325</td>
<td>3</td>
</tr>
<tr>
<td>Layout and Design of Publications—Jl 342</td>
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</tbody>
</table>

Additional courses are required of students in fashion illustration who must declare this intention no later than the first quarter of the junior year.

<table>
<thead>
<tr>
<th>Course</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fashion Illustration—A A 278, 279</td>
<td>6</td>
</tr>
<tr>
<td>Special Problems—A A 490G</td>
<td>2-3</td>
</tr>
<tr>
<td>Textiles—T &amp; C 204</td>
<td>4</td>
</tr>
<tr>
<td>History of Costume—T &amp; C 454</td>
<td>3</td>
</tr>
<tr>
<td>Electives</td>
<td>31-41</td>
</tr>
</tbody>
</table>

Major in Craft Design

This major provides a broad background in crafts with a strong emphasis in two craft media. In addition to the core curriculum requirements, the following courses are to be completed:

<table>
<thead>
<tr>
<th>Course</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Applied Art—A A 104</td>
<td>3</td>
</tr>
<tr>
<td>Design—A A 150</td>
<td>3</td>
</tr>
<tr>
<td>Lettering—A A 170</td>
<td>3</td>
</tr>
<tr>
<td>Color—A A 203</td>
<td>3</td>
</tr>
<tr>
<td>Water Based Media—A A 233</td>
<td>3</td>
</tr>
<tr>
<td>Intermediate Drawing—A A 250</td>
<td>3</td>
</tr>
<tr>
<td>History of Art—A A 301, 302, 303</td>
<td>9</td>
</tr>
<tr>
<td>Painting—A A 333</td>
<td>3</td>
</tr>
<tr>
<td>Select six craft courses—Structural Fabric Design—A A 243; Weaving—A A 244; Design in Metal and Enamel—A A 247; Ceramics—A A 346; Design in Wood—A A 345; Applied Textile Design—A A 347; Jewelry—A A 446.</td>
<td>18</td>
</tr>
</tbody>
</table>

Craft design majors must take a concentration in two areas of nine credits each: Applied Textile Design—A A 348 and 490B; Weaving—A A 243 or 244: 245 and 490C; Ceramics—A A 490D; Jewelry—A A 490J; Design in Wood—A A 490K; Design in Metal and Enamel—A A 490L. 18

Technical Drawing for Applied Art—E Gr 121 3

Major in Art Education

This major is planned for students preparing for certification to teach art in grades kindergarten through twelve.

<table>
<thead>
<tr>
<th>Course</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Home Economics core—Total credits 16-18</td>
<td></td>
</tr>
<tr>
<td>Applied Art, Textiles and Clothing—A A 103</td>
<td>4</td>
</tr>
<tr>
<td>Equipment and Housing—Select from F E 240, 254, 308, 315, 412</td>
<td>3</td>
</tr>
<tr>
<td>Family and the Child—Select from C D 128, 225, F E 185, 265</td>
<td>3-4</td>
</tr>
<tr>
<td>Management—Select from F E 341, 488</td>
<td>3</td>
</tr>
<tr>
<td>Nutrition—F &amp; N 107, 232</td>
<td>3-4</td>
</tr>
<tr>
<td>Professional Relations—H Ec 400</td>
<td>R</td>
</tr>
<tr>
<td>Biological sciences—Total credits 9</td>
<td></td>
</tr>
<tr>
<td>Principles of Biology—Biol 101</td>
<td>3</td>
</tr>
<tr>
<td>Select from Biol 102B or Zoö 158</td>
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</tr>
<tr>
<td>Select from bacteriology, biology, botany, genetics, zoology</td>
<td>3</td>
</tr>
<tr>
<td>Physical sciences, mathematics, and statistics</td>
<td>3</td>
</tr>
<tr>
<td>Select from chemistry, geology, mathematics, meteorology, physics, statistics</td>
<td>9</td>
</tr>
</tbody>
</table>

Core Curriculum Requirements
Curriculum in Child Development

Leading to the degree of Bachelor of Science. Total credits required—195.

The student majoring in child development may select one of two options: (1) nursery school-kindergarten education, or (2) community services for children.

Nursery School/Kindergarten

Education Option

Home Economics core........................................Total credits 16
Applied Art, Textiles and Clothing—Select from AA 103, 150, 200, 384, T&C 204, 121, 328A, 318A.................. 3
Equipment and Housing—Select from F E 240, 264, 318A.................. 3
Family and the Child—Select from F E 285, 385.................. 3
Management—Select from F E 375, 415, 488.................. 3
Nutrition and the Family's Food—F & N 107.................. 4
Professional Relations—H E 400.................. 3
Child Development........................................Total credits 58
Principles of Child Development—C D 129.................. 3
Professional Experiences With Children—C D 217.................. 2
Development in Infancy—C D 224, 225.................. 4
Development of the Child—C D 344, 345.................. 4
Development and Guidance in Later Childhood—
C D 226.................. 3
Literature for Children—C D 240.................. 4
Seminar and Field Trip—C D 318, C D 318L.................. 2
Activities and Materials, Lab Participation—C D 341, 341L.................. 5
Introduction to Child Development—C D 369.................. 3
Guidance of Children—C D 424.................. 4
Planning and Administration of Programs for
Children—C D 443.................. 5
Child, Family and Community Relations—C D 449.................. 2
Supervised Teaching, Nursery School/Kindergarten—
C D 317A, 317B.................. 8
Supervised Teaching in Child Centers—C D 417B.................. 8
Biological sciences........................................Total credits 12
Principles of Biology—Biol 101.................. 3
Introduction to Human Physiology and Anatomy—
Zool 105.................. 3
Select from biology, botany, genetics, zoology.................. 6
Physical sciences........................................Total credits 9
Select from chemistry, earth sciences, mathematics,
physics, statistics.................. 9
Social sciences........................................Total credits 21
Principles of Economics—Econ 241 or 242.................. 3
Select from American History or American
Government.................. 3
Introduction to Anthropology—Anthro 111.................. 3
Introduction to Sociology—Soc 134.................. 3
Developmental Psychology—Psych 230.................. 3
Psychology option.................. 4
Professional Education..................................Total credits 17
Educational Psychology—Psych 333.................. 5
Foundation of American Education—Ed 204.................. 3
Methods of Teaching—Ed 305A, 305B.................. 4
Principles of Secondary Education—Ed 426.................. 3
Principles of Teaching in the Elementary School—
El Ed 344A, El Ed 344B.................. 2
Liberal Instruction—Lib 160.................. 1
Physical education.................. 3
Electives............................................ 15-17

Humanities........................................Total credits 15
Select from foreign language, history, design center
(125, 126, 127), distributed studies 201-209, literature,
music (and performing arts), philosophy
Written and spoken English.................. 6
Community Services for Children Option

Home Economics core........................................Total credits 15
Applied Art, Textiles and Clothing—Select from
AA 103, 150, 200, 384, T&C 204, 121, 328A.................. 3
Equipment and Housing—Select from F E 240, 264, 318A.................. 3
Family and Child—Principles of Child Development—
C D 129.................. 3
Management—Select from F E 375, 415, 488.................. 3
Nutrition—Select from F & N 107, 232.................. 3
Professional Relations—H E 400.................. 3
Child Development........................................Total credits 53
Professional Experiences With Children—C D 217.................. 2
Development in Infancy—C D 224.................. 4
Development in Early Childhood—C D 225.................. 4
Curriculum in Family Environment

Leading to the degree Bachelor of Science. Total credits required—195.

The department offers three options: family services, consumer services and general home economics. All options focus on the family as and in environment. The subject matter areas within family environment include courses in consumer behavior, family, household equipment, housing and management.

Core Curriculum Requirements

Home Economics—Family Environment ................................. Total credits 30-32
Art, Textiles and Clothing—Select from applied art or textiles and clothing ................................. 3-4

Equipment and Housing—Select from F E 254, 304, 318, 340, 341, 408A, 412, 445, 446 ................................. 6
Family and Child—Select from C D 129, F E 270, 285, 385 ................................. 6
Management—Select from F E 375, 415, 488 ................................. 6
Nutrition—Select from F & N 107, 222 ................................. 3-4
Families and Their Environment—F E 185 ................................. 3
Introduction to Family Housing—F E 240 ................................. 3
Professional Relations—H E 400 ................................. 3
Biological sciences .................................. Total credits 8
Principles of Biology—Biol 101 ................................. 3
Select from biology, bacteriology, botany, zoology, genetics ................................. 5
Physical Sciences, Statistics, Mathematics .................................. Total credits 8-9
Select from chemistry, geology, mathematics, meteorology, physics, statistics
Social sciences .................................. Total credits 15
Principles of Economics—Econ 241 or 242 ................................. 3
Select from American History or American Government ................................. 3
Introduction to Anthropology—Anthro 111 ................................. 3
Introduction to Sociology—Soc 134 ................................. 3
Psychology option ................................. 3
Area of concentration .................................. Total credits 30
Select one: cultural emphasis, exceptional child, recreation, creative expression, biological sciences, and family patterns. Option is to be selected during the sophomore year with the aid of the adviser, and filed with a committee for approval. Six to eight credits may be adjusted with consent of adviser.

Humanities .................................. Total credits 15
Select from foreign languages, history, design center, literature, music ( omit performing arts), philosophy
Written and spoken English .................................. Total credits 11
Language in Composition and Reading—Engl 104, 105 ................................. 8
Fundamentals of Speech—Sp 211 ................................. 3
Library Instruction—Lib 160 ................................. 1
Physical education ................................. 3
Electives .................................. 35

Family Services Option

This option provides preparation for students who desire employment with public and private family service agencies, youth organizations and home economics extension.

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

Family Environment .................................. Total credits 21-31
Management in the Family—F E 376 ................................. 3
Family Services—F E 386, 396 ................................. 3
Rehabilitation Principles and Services—F E 480 ................................. 3
Communication With Families—F E 470 ................................. 3
Planning Change in the Family Environment—F E 485 ................................. 3
Practicum—F E 481 ................................. 3-16

Select 12 additional credits in home economics.
Select 15 credits from the following areas, taking courses from at least two of the areas: sociology and anthropology, psychology, education, communications.

Consumer Services Option

This option provides preparation for students who desire employment with governmental and private consumer service agencies and/or businesses related to management and consumer education, household equipment and housing.

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

Family Environment .................................. Total credits 12
Equipment in the Home—F E 238 ................................. 3
Families as Consumers—F E 419 ................................. 3
Housing Alternatives for Individuals and Families—F E 446 ................................. 3
Communications With Families—F E 470 ................................. 3
Select 21 additional credits in home economics.*
Select 21 credits from the following areas, taking courses from at least three of the areas: industrial administration, consumer psychology, economics and sociology, journalism and mass communication, computer science, statistics, architecture and urban planning, education.*
Electives................................................................. 56-59

General Home Economics Option

This option provides the student with an opportunity for a broad based education which draws from several areas of home economics. This option is non-professionally oriented.

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

Home Economics
Students will select 24 credits from at least three of the following departments of the College of Home Economics: Child Development, Family Environment, Food and Nutrition, Home Economics Education, Institution Management, Physical Education for Women, Textiles and Clothing.*

Humanities and Social Sciences
Students will select 21 credits from the humanities or social sciences.*
Electives................................................................. 56-59

*Departmental office will provide a current listing of suggested courses to aid students in making selections.

Curriculum in Food and Nutrition

Leading to the degree Bachelor of Science. Total credits required—195.

The department offers four majors: community nutrition, dietetics, food science, and food and nutrition and related science.

Each of the programs provides for competencies in food and nutrition needed by volunteer workers for foreign programs. Electives may be applied toward meeting the requirements for certification for teaching.

All majors except food and nutrition and related science have the following courses in common. Students with special areas of interest, such as chemistry, may, in consultation with an adviser, use elective credit to substitute longer sequences of courses for those listed.

Core Curriculum Requirements

<table>
<thead>
<tr>
<th>Home Economics core</th>
<th>Total credits 18-19</th>
</tr>
</thead>
<tbody>
<tr>
<td>Applied Art, Textiles and Clothing—A A 103</td>
<td>4</td>
</tr>
<tr>
<td>Equipment and Housing—Select from A A 261; F E 240, 254; I Mgt 485</td>
<td>3-4</td>
</tr>
<tr>
<td>Family and the Child—Select from C D 129; F E 270, 285</td>
<td>3</td>
</tr>
</tbody>
</table>

- Management—Quantity Food Production Management—I Mgt 380 ........................................ 4
- Nutrition—Nutrition and the Family’s Food—F & N 107 .................................................. 4
- Professional Relations—H Ec 400 ........................................................................ R
- Food and Nutrition core ........................................................................ 18
- Food I, II—F & N 214, 215 ............................................................................. 8
- Family Meal Management—F & N 303 ........................................................................ 4
- Nutrition and Dietetics—F & N 305 ........................................................................ 4
- Seminar in Food and Nutrition—F & N 404 ................................................. 2

Biological sciences .................................................. Total credits 15
- Introductory Bacteriology—Bact 300 ............................................. 5
- Principles of Biology—Biol 101 A ......................................................... 3
- Experimental Biology—Biol 101 A ......................................................... 3
- Human Physiology and Anatomy—Zool 155, 156 ........................................ 5

Physical sciences .......................................................... Total credits 22
- General Chemistry—Chem 141, 142, 141L, 142L ..................................... 8
- Survey of Biochemistry—B & B 301 ......................................................... 3
- Laboratory in Biochemistry—B & B 311 .................................................. 3
- Elementary Physics—Phys 106 ............................................................... 4

Social sciences .................................................. Total credits 16
- American Government—Pol S 215 ......................................................... 3
- Developmental Psychology—Psych 230 .................................................. 3
- Introduction to Sociology—Soc 134 ......................................................... 3
- History .................................................. Total credits 16
- Select from philosophy, literature, foreign languages, music, history ................. 6

Written and spoken English .................................................. Total Credits 11
- Language in Composition and Reading—Engl 104, 106, 205 .................................. 8
- Fundamentals of Spanish—Sp 211 .......................................................... 3
- Library Instruction—Lib 160 ....................................................................... 1
- Physical education .................................................................................. 3

Major in Community Nutrition

This major provides basic preparation for students who desire employment with nutrition services of social welfare agencies, public health departments, commercial organizations, or extension.

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

<table>
<thead>
<tr>
<th>Home Economics</th>
<th>Total credits 21</th>
</tr>
</thead>
<tbody>
<tr>
<td>Family Finance—F E 488</td>
<td>3</td>
</tr>
<tr>
<td>Diet Therapy I, II—F &amp; N 431, 432</td>
<td>6</td>
</tr>
<tr>
<td>Nutrition During Human Growth and Development—F &amp; N 410</td>
<td>3</td>
</tr>
<tr>
<td>Experimental Studies of Food—F &amp; N 411 .................................................. 4</td>
<td></td>
</tr>
<tr>
<td>Community Nutrition—F &amp; N 413 .................................................................... 3</td>
<td></td>
</tr>
<tr>
<td>Seminar in Community Nutrition—F &amp; N 414 ............................................. 3</td>
<td></td>
</tr>
<tr>
<td>Biological sciences—Select from Gen 360, Zool 356 .................................. 3-4</td>
<td></td>
</tr>
</tbody>
</table>

- Introduction to Statistics—Stat 104 ......................................................... 5
- Social sciences .................................................. Total credits 8
- Educational Psychology—Psych 333 ......................................................... 5
- Group Dynamics—Soc 264 ........................................................................ 3
- Publicity and Public Relations—Jl 225 ...................................................... 3-35
- Electives .................................................................................................. 34-35

Major in Dietetics

This major serves the interests of the student who wishes to be prepared to work in nutrition education, including the medical aspects of nutrition, and in food service. The program gives preparation for hospital and other dietetic internship programs. Courses included meet the academic requirements of the American Dietetic Association for both general
and therapeutic internships. Requirements for the specialized internship in community nutrition are met by the community nutrition major.

In addition to the core 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>Field Study Tour—F &amp; N 400 A</td>
<td>R</td>
</tr>
<tr>
<td>Diet Therapy I, II—F &amp; N 431, 432</td>
<td>6</td>
</tr>
<tr>
<td>Nutrition During Human Growth and Development—F &amp; N 410</td>
<td>3</td>
</tr>
<tr>
<td>Experimental Studies of Food—F &amp; N 411</td>
<td>4</td>
</tr>
<tr>
<td>Methods of Teaching Nutrition—F &amp; N 418</td>
<td>3</td>
</tr>
<tr>
<td>Purchasing and Inventory Management—I Mgt 484</td>
<td>4</td>
</tr>
<tr>
<td>Organization and Management—I Mgt 487</td>
<td>3</td>
</tr>
<tr>
<td>Personnel Management in Institutions—I Mgt 488</td>
<td>3</td>
</tr>
<tr>
<td>Supervised Hospital Experience—F &amp; N 430</td>
<td>3</td>
</tr>
<tr>
<td>Biological sciences—Select from Gen 360, Zool 356, Gen 400</td>
<td>34</td>
</tr>
<tr>
<td>Educational Psychology—Psych 333</td>
<td>5</td>
</tr>
<tr>
<td>Select from JI 225 or any course in written English</td>
<td>3</td>
</tr>
<tr>
<td>Select from Stat 104, Com S 100, I E 108</td>
<td>3-5</td>
</tr>
<tr>
<td>Electives</td>
<td>28-33</td>
</tr>
</tbody>
</table>

**Major in Food Science**

This major serves those who are interested in developing food products for the market in food promotion programs in industries, in experimental food kitchens, in food research laboratories, in writing food columns for papers and magazines, and in directing food programs on radio and television. This program also leads to careers in consumer services in business and industry. For emphasis in food marketing and advertising, it is recommended that additional courses be selected from economics, psychology, and statistics.

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

**Home Economics**

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Family Finance—F E 488</td>
<td>3</td>
</tr>
<tr>
<td>Fundamentals of Food Measurements—F &amp; N 320</td>
<td>3</td>
</tr>
<tr>
<td>Field Study Tour—F &amp; N 400 B</td>
<td>R</td>
</tr>
<tr>
<td>Select from F &amp; N 410, 413, 433</td>
<td>3</td>
</tr>
<tr>
<td>History of Food—F &amp; N 420</td>
<td>3</td>
</tr>
<tr>
<td>Principles of Food Science I, II—F &amp; N 421, 422</td>
<td>3</td>
</tr>
<tr>
<td>Introduction to Research in Food Science—F &amp; N 423</td>
<td>3</td>
</tr>
<tr>
<td>Dynamics of Family Food Economy—F &amp; N 419</td>
<td>3</td>
</tr>
<tr>
<td>Written and Spoken English—Total credits 9</td>
<td></td>
</tr>
<tr>
<td>Speech elective</td>
<td>3</td>
</tr>
<tr>
<td>Publicity and Public Relations—JI 225</td>
<td>3</td>
</tr>
<tr>
<td>Select from: JI 325, Engl 414</td>
<td>3</td>
</tr>
<tr>
<td>Select from physical and biological sciences, economics, mathematics, and statistics</td>
<td>5</td>
</tr>
<tr>
<td>Electives</td>
<td>35-36</td>
</tr>
</tbody>
</table>

**Curriculum in Home Economics**

Leading to the degree Bachelor of Science. Total credits required—195.

**Major in International Studies**

Students in this curriculum may develop a program with emphasis in international service. This is designed to provide students with a background for participation in government or agency programs, as well as provide an opportunity to become oriented to national and international affairs as part of the responsibility of citizenship in its broadest sense. For further information, see Index: International Studies.

The curriculum requirements are:
Curriculum in Home Economics Education

Leading to the degree Bachelor of Science. Total credits required—195.

The curriculum is planned for those who wish to prepare for teaching a variety of home economics programs including career and vocational education in junior and senior high schools and in adult education. Further information appears under College of Education.

Home Economics core .................................. Total credits 40-45
A A 103 or 384 ............................................. 3-4
C D 128 or 228 ............................................. 6
F E 240, 415, 488 and 340 or 385 .................. 12
I Mgt 287 or F E 375 ..................................... 2-3
F & N 107 and 208 or 214, 215 ....................... 9-12
T & C 122, 204 ............................................. 8
H Ec 400 .................................................... R

In addition, select from one area Total credits 13-16
A. Food and Nutrition: F & N 305, 410, 413, 414 and 411 or 415 .................. 15-16
B. Textiles and Clothing: T & C 223, 246, 466, 528 ....... 13
C. Child and Family: C D 224, 225 or 226 and 341, 341L, F E 470 or 485 ...... 13-14

Biological sciences ................................... Total credits 10
Biol 101, 102A ............................................. 5
Zool 155, 156 .............................................. 5

Physical sciences and mathematics .......... Total credits 21
Chem 141, 141l, 142, 142L, 231 ...................... 11
Math 104 .................................................... 5
Stat 101 ..................................................... 5

Written and spoken English .................... Total credits 11
Engl 104, 105 .............................................. 8
Sp 211 ...................................................... 3

Social sciences ........................................ Total credits 28-30
Anthro 111 and 313, 321, 340, 400 or 425 ........ 6-7
Econ 241 and 306, 411 or 380 ....................... 6-7
Pol S 215 .................................................... 3
Psych 230 ................................................. 3
Soc 134, 415 and 304, 430, 410 or 411 .......... 10-11

Study of a single geographic area .......... Total credits 6
See Index, International Studies. Select from Africa, Middle East, Asia, Latin America, Russia or Western Europe.

Foreign language—Minimum of 2 years
In one language .................................. Total credits 19-24
University Studies 430 .................. Total credits 3
Physical education .................................. Total credits 3
Library 160 ............................................. Total credits 1
Electives (including prerequisites not listed above) .................. Total credits 25-40

Development and Guidance in Later Childhood—
C D 226 ................................................... 4
Select from F E 415 or 488 ........................... 3
Select from F E 489 or I Mgt 380 ................. 3-4
Principles of Food Preparation—F & N 208 ...... 5
Family Meal Management—F & N 303 ........... 4
Housing—Select from A A 262; Arch 361; F E 240, 308, 412 .................. 3
Textiles—T & C 204 .................................... 4
Select from T & C 122 or 222 ...................... 4
Clothing Selection—T & C 245 ..................... 3

Area of concentration ................................ Total credits 12

Option 1. Select home economics and supporting courses in one area of concentration: food and nutrition, institution management, housing and equipment, human development and the family, home management and family economics, textiles and clothing.

Option 2. Select home economics courses from two or more of the areas listed above.

Professional education .......................... Total credits 35
Foundations of American Education—Educ 204 .... 3
Methods of Teaching—Educ 305A, 305B ............ 4
Principles of Secondary Education—Educ 426 .... 3
Methods of Teaching Home Economics—H Ed 406 .. 4
Supervised Teaching in Home Economics—H Ed 407... 9
Planning and Evaluating Home Economics Programs—H Ed 410 ......... 4
Supervised Experiences in Home Economics Education—H Ed 417 .......... 3
Educational Psychology—Psych 333 ............... 5

Biological sciences .................................. Total credits 8
Principles of Biology—Biol 101 ...................... 3
Elementary Human Physiology—Zool 155 ........... 3
Select from bacteriology, biochemistry and biology, biology, botany, genetics, zoology .... 2

Physical sciences ................................... Total credits 16
General Chemistry—Chem 141, 142, 141L, 142L .... 8
Elementary Organic Chemistry—Chem 231, 232C ... 4
Elementary Physics—Phys 106 ..................... 4

Social sciences* ...................................... Total credits 15
Principles of Economics—Econ 241 or 242 ... 3
Developmental Psychology—Psych 230 ........... 4
Introduction to Sociology—Soc 104 ............... 3
Select from anthropology, economics, political science, psychology, sociology .......... 5

Humanities ............................................. Total credits 15
Select from history, literature, foreign languages, music, philosophy.

Written and spoken English .................... Total credits 14
Language in Composition and Reading—Engl 104, 105 ................. 8
Fundamentals of Speech—Sp 211 .................... 3
Select from Engl 204; Sp 305, 313, 317, 318 .... 3
Library Instruction—Lib 160 ......................... 1
Physical education ................................... 3
Electives .................................................. 20-21

*Humanities must include 3 credits of American history, or social science must include Pol S 215.
Curriculum in Home Economics Journalism

Administered by the dean of the College of Home Economics.

Leading to the degree Bachelor of Science. Total credits required—195.

Home Economics core............................................ Total credits 18
(Select courses in each area.)

Home Economics concentration.................................. Total credits 21
(Select courses in one subject area.)

Journalism and Mass Communication—Total credits 38
Introduction to Mass Communication—Jl 101.................. 2
Basic Reporting, Writing, Editing—Jl 201, 202, 203............
Journalism 300-level courses.................................. 12
Journalism 400-level courses.................................. 9
Home Economics Journalism Seminar—Jl 490N.............. 1
*Professional Work Requirement—Jl 490J ..................... 3
General Education core............................................ Total credits 58
(Select courses in each area.)

Electives............................................................ Total credits 60

*Jl 490J professional work requirement involves three months full-time work, or equivalent, in professional mass communication. Students in home economics with a major in journalism have opportunities for practical experience through work on campus publications, including Outlook, published by home economics students. Many students also lay foundations for active careers by contributing to magazines and newspapers and by participating in productions for the University stations WOI-AM, FM and TV.

Curriculum in Institution Management

Leading to the degree Bachelor of Science. Total credits required—195.

The three majors within the institution management curriculum—college food and housing administration, hotel and restaurant management, and school food service—meet the academic requirements for membership in the American Dietetic Association and qualify the student for an internship approved by the Association. Graduates of this curriculum are also eligible for membership in national associations representing the hotel, restaurant, and school food-service industries.

By careful planning of program and use of electives, a student majoring in school food service may meet the certification requirements for teaching home economics in high school.

Core Curriculum Requirements

Home Economics core............................................ Total credits 17-18
Applied Art, Textiles and Clothing—Select from
A A 103, 394 .................................................. 3-4
Equipment and Housing—Layout and Equipment,
I Mgt 495 ......................................................... 4
Family and the Child—Select from C D 129; F E 270,
285, 388 ......................................................... 3

Management—Introduction to Institution Management,
I Mgt 287 ......................................................... 3
Nutrition—Nutrition and the Family’s Food, F & N
107 ......................................................... 4
Professional Relations—H Ec 400 ................................... R
Institution Management core.................................. Total credits 44
Meat for Institution Food Service—An S 371 ................. 3
Foods I—F & N 214 .............................................. 4
Foods II—F & N 215 ............................................ 4
Principles of Accounting I—I Ad 384 ......................... 4
Quantity Food Production Management—I Mgt 390 .... 4
Study Tour—I Mgt 400 .......................................... 1
Seminar—I Mgt 404 .............................................. 2
Purchasing and Inventory Management—I Mgt 484 .... 4
Institution Management Experience—I Mgt 488A, 488B
Organization and Management—I Mgt 487 ................. 3
Personnel Management in Institutions—I Mgt 488 .... 3
Additional Management ........................................ 3
Textiles—T & C 204 .............................................. 4

Biological sciences............................................. Total credits 15
Introductory Bacteriology—Bact 300 ......................... 5
Principles of Biology—Biol 101 .................................. 3
Experimental Biology—Biol 101A ................................. 2
Introduction to Human Physiology and Anatomy—
Zool 155, 156 ..................................................... 5

Physical sciences.................................................. Total credits 12-13
General Chemistry—Chem 141, 142, 141L, 142L .......... 8
Elementary Organic Chemistry—Chem 231; 232B or
232C ................................................................. 4-5
Social sciences..................................................... Total credits 15-16
Principles of Economics—Econ 241, 242 ......................... 6
American Government—Pol S 215 ............................... 6
General Psychology—Psych 101 .................................. 3
Introduction to Sociology—Soc 134 ................................ 3-4

Humanities.......................................................... Total credits 15
Select from history, philosophy, literature, foreign
languages, music.
Written and spoken English................................ Total credits 11
Language in Composition and Reading—Engl 104,
105 ................................................................. 8
Fundamentals of Speech—Sp 211 .................................. 3
Library Instruction—Lib 160....................................... 1
Physical education .................................................. 3

Major in College Food and Housing Administration

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

Housing and Social Program Management—I Mgt 488C
488D ................................................................. 3
House Administration—I Mgt 489 .................................. 3
Concentrations...................................................... Total credits 14
Survey of Biochemistry—B & S 301, and ......................... 3
Methods of Teaching—Educ 205, 206, 207 ..................... 3
Nutrition and Dietetics—F & N 305, and ....................... 4
Experimental Studies of Food—F & N 411 ..................... 4
or
Labor Economics and Labor Relations—Econ 305 .... 5
Business Law I—I Ad 365 and ................................. 3
Hotel and Restaurant Accounting—I Mgt 450 and ........ 3
Legal Aspects of Hotel and Restaurant Management—
I Mgt 490 and .................................................. 3
Select from Educ 204, 306A; Psych 230, 333; Soc 264,
380, 450 ............................................................. 9
Electives .............................................................. 30-33

Major in Hotel and Restaurant Management

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

Housing and Social Program Management—I Mgt 488C
488D ................................................................. 3
House Administration—I Mgt 489 .................................. 3
Concentrations...................................................... Total credits 14
Survey of Biochemistry—B & S 301, and ......................... 3
Methods of Teaching—Educ 205, 206, 207 ..................... 3
Nutrition and Dietetics—F & N 305, and ....................... 4
Experimental Studies of Food—F & N 411 ..................... 4
or
Labor Economics and Labor Relations—Econ 305 .... 5
Business Law I—I Ad 365 and ................................. 3
Hotel and Restaurant Accounting—I Mgt 450 and ........ 3
Legal Aspects of Hotel and Restaurant Management—
I Mgt 490 and .................................................. 3
Select from Educ 204, 306A; Psych 230, 333; Soc 264,
380, 450 ............................................................. 9
Electives .............................................................. 30-33
Major in School Food Service

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

- Survey of Biochemistry—B & B 301
- Methods of Teaching—Educ 305A, 305B
- Nutrition and Dietetics—F & N 305
- Experimental Studies of Food—F & N 411
- Education: Select from Educ 204, 426; Psych 230, 333
- Food and Nutrition: Select from F & N 410, 413, 414, 418, 431
- Electives

Curriculum in Physical Education for Women

Leading to the degree Bachelor of Science. Total credits required—195.

See College of Sciences and Humanities for group requirements leading to a degree through the College of Sciences and Humanities.

The curriculum in physical education for women prepares the student to teach physical education and/or dance in the elementary and secondary schools or for professional work in a wide variety of related areas. An area of concentration in dance is available to students who have majors in other departments or colleges.

Every student majoring in physical education is required to have at least 70 credits in courses numbered 300 or higher prior to receiving the bachelor's degree. Not more than 65 credits in physical education professional courses may apply toward the 195 credits required for graduation.

I. Core Curriculum Requirements .22 credits

All majors in physical education and/or dance must complete the following:
- Perspectives of Physical Education—PEW 190
- Biomechanics of Human Movement—PEW 359
- Physiology of Exercise—PEW 480
- Principles of Motor Performance—PEW 370
- History and Philosophy of Physical Education—PEW 440 (for dance option, substitute PEW 380)
- Socio-Psychological Effectors of Movement—PEW 380

II. Certification Programs

Students who wish to prepare for teaching physical education and/or dance in the elementary and secondary schools must complete the following requirements:

A. General Education.............. Total credits 77

B. Professional Education............ Total credits 31

C. Physical Education.............31-42 credits
Laboratories, individual interest. Agencies, media, institutions, industries, and teaching major in physical education have opportunities. Nonteaching Programs

**Phyalcal and Social Sciences**

1. Introduction to Human Physiology and Anatomy—Zool 155, 166
2. Anatomy of Human Movement—Zool 327
3. Physical sciences, mathematics, statistics
4. Social sciences
5. Human behavior—Psy 101
6. Introduction to Sociology—Soc 134
7. Humanities
8. Communicative arts
9. Library Instruction—Lib 160

**III. Nonteaching Programs**

This major is planned for students who are interested in an interdisciplinary approach to the study of human movement. Students with a nonteaching major in physical education have opportunities for careers associated with recreational agencies, media, institutions, industries, and research laboratories in universities or colleges. This major permits the student to plan a program suited to individual interest.

**A. General education**

1. Introduction to Human Physiology and Anatomy—Zool 155, 166
2. Anatomy of Human Movement—Zool 327
3. Physical sciences, mathematics, statistics
4. Social sciences
5. Human behavior—Psy 101
6. Introduction to Sociology—Soc 134
7. Humanities
8. Communicative arts
9. Library Instruction—Lib 160

**B. One of the following options:**

1. **Nonteaching Program in Physical Education**
   - Physical education professional courses
   - Area of specialization
   - Total credits 8
   - Area and program must be approved by Department of Physical Education for Women

2. **Nonteaching Program in Dance and Related Arts**
   - Dance courses
   - Total credits 23-31
   - Area of specialization in related arts
   - Total credits 30
   - Area and program must be approved by Department of Physical Education for Women

**Dance Concentration Area**

An area of concentration in dance is available to students who have majors in other departments or colleges.

---

**Curriculum in Textiles and Clothing**

Leading to the degree Bachelor of Science. Total credits required—195.

The department offers majors in textiles and clothing, and textiles and clothing and related science. Options within each major permit the student to plan a program suited to individual interest.

Courses required of all textiles and clothing majors:

**Core Curriculum Requirements**

1. **Home Economics Core**
   - Total credits 16-18
   - Applied Art, Textiles and Clothing—A A 103, 141, 142
   - Equipment and Housing—Select from: A A 281, 282, 283, 284, 285
   - Family and the Child—Select from: C D 129, 130
   - Management—Select from: F E 240, 241, 242
   - English—Select from: F E 375, 415, 416
   - Nutrition—Select from: F N 107, 285, 286, 287
   - Professional Relations—H Ec 400, 401, 410
   - Textiles and clothing core
   - Total credits 13-14
   - Textiles—T & C 204
   - Pattern Making and Clothing Construction—T & C 222
   - Sophomore Seminar—T & C 210
   - Clothing Selection—T & C 245
   - Senior Study Tour—T & C 450
   - Senior Seminar—T & C 440

2. **Biological Science**
   - Total credits 8
   - Introduction to Human Physiology and Anatomy—Zool 155
   - Principles of Biology—Biol 101
   - Physical sciences and mathematics
   - Total credits 15
   - General Chemistry—Chem 141, 142
   - Elementary Organic Chemistry—Chem 241, 242
   - Mathematics
   - Social science
   - Total credits 15
   - Principles of Economics—Econ 141, 142
   - General Psychology—Psych 101
   - Introduction to Sociology—Soc 134
Major in Textiles and Clothing

This major may lead to careers in merchandising, fashion promotion, commercial or costume designing, or educational positions with industry.

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

**Drawing—A A 150** ................................................................. 3
**Fashion Illustration—A A 278** ............................................... 3
Select **Engl** 302 or Sp 312 .................................................. 3
Select **I Ad** 340 or Econ 466 ................................................ 3
Select **Jl** 225 or 325 ............................................................ 3
**Psychology of Sales and Advertising—Psych 250** ...................... 3
**Applied Textiles—T & C 304** .................................................. 4
**Costume Design—T & C 345** .................................................. 4
**Sociological and Psychological Aspects of Clothing and Textiles—I—T & C 465** .................................................. 3

**Design Option**

- **Fashion Illustration—A A 279** ............................................ 3
- **History of Art—A A 301, 302, 208** ...................................... 3
- Select from **A A 347, 243, 244** ......................................... 3
- **Draping—T & C 223** .......................................................... 3
- Select **T & C 336A, 336B or T & C 429** ................................ 4
- **Historic Textiles—T & C 455** ............................................. 3
- **History of Costume—T & C 454** ......................................... 3
- Select from **I Ad 365, 384; T & C 375** ................................. 3-4
- Electives ................................................................. 36-40

**Merchandising Option**

- **Fundamentals of Interior Design—A A 261** ............................. 4
- **Textiles and Clothing Merchandising—T & C 375** ...................... 3
- **Advanced Textiles—T & C 404** ......................................... 3
- Select **T & C 465 or T & C 454** .......................................... 3
- **Family Clothing Consumption—T & C 464** .............................. 3
- **Principles of Accounting—I Ad 384** ................................... 4
- Select from **I Ad 365, 443, 488, 444; Com S 441A; Econ 305; Soc 380** .................................................. 8-9
- Electives ................................................................. 44-48

*May be used to satisfy options.

**Major in Textiles and Clothing and Related Science**

This major prepares the student for graduate study or for research. The two options make it possible to emphasize either the physical or the social sciences.

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

**Pre Calculus Mathematics—Math 109** .................................. 5
**Writing of Reports and Technical Papers—Engl 414** .................. 3
**Foreign Language** ............................................................ 12

**Physical Science Option**

- **Applied Textiles—T & C 304** ............................................. 4
- **Advanced Textiles—T & C 404** ......................................... 3
- **Historic Textiles—T & C 455** ............................................ 3
- **Equipment for Care of Modern Textiles—F E 408A, 408B** ........... 4
- **Quantitative Analysis—Chem 211** ....................................... 5
- **Organic Chemistry—Chem 334, 335** .................................... 6
- **General Physics—Phys 111** ............................................... 4
- **Analytic Geometry and Calculus—Math 120, 121** .................... 10
- Nine or more credits in a single subject matter area ............................. 9
- **Bact 300, 301; Com S 201, 202, 381; Stat 401, 402, 481, 482; Bot 107, 404 and Speech Problems** 
- Electives ................................................................. 42-45

**Social Science Option**

- **History of Costume—T & C 464** ......................................... 3
- **Family Clothing Consumption—T & C 464** .............................. 3
- **Sociological and Psychological Aspects of Clothing and Textiles—I—T & C 465** .................................................. 3
- Options: Select from one ................................................... 15
- **Economics** ................................................................. 9
- **Math 120, 121; Stat 380, 401, 402, 403, 421, 447, 448; Com S 201, 202, 301, 361** .................................................. 6
- **Sociology** ................................................................. 6
- **Soc 201, 330, 485; F E 485, 385** ......................................... 9
- **Soc 302, 484** ............................................................... 6
- **Anthropology** ............................................................... 9
- **Anthro 111, 215, 220, 424** ................................................ 9
- **Anthro 425, 425A, 430; Hist 339** ........................................ 6
- **Psychology** ................................................................. 6
- **Psych 202, 206, 230** ..................................................... 6
- **Psych 301, 302, 440** ..................................................... 6
- Select from above list and other courses in economics, sociology, anthropology, and psychology ................................. 18-20
- Electives ................................................................. 38-43

*May be used to satisfy options in Core.
**May be used to meet requirements in T & C Core.
The College of Sciences and Humanities offers opportunities for study in many fields of the mathematical, physical, biological, and social sciences; in methods and systems of communication; in the arts and humanities; and in health studies and physical education. The degree requirements are sufficiently flexible to permit planning individual programs of study suited to many different interests, abilities, and goals. The college has two curricula: a curriculum in sciences and humanities leading to the Bachelor of Arts and the Bachelor of Science degrees; and a curriculum in music leading to the Bachelor of Music. Every student is required to earn at least 70 credits in courses numbered 300 or higher prior to receiving the bachelor's degree.

Curriculum in Sciences and Humanities

For the degrees Bachelor of Arts and Bachelor of Science the student must earn a total of at least 192 credits distributed as follows:

1. At least 70 credits in general education.
2. At least 35, but not more than 70, credits applied to the major, including any courses numbered 100 and above in the major department or discipline.
3. At least 40 credits freely elected by the student. If the student elects a minor or a second major, the minimum number of credits of free electives shall be reduced as required to satisfy the minimum number of credits required for graduation.
4. An optional minor of at least 20 credits, including any courses numbered 100 and above in the minor department or discipline.
5. A cumulative grade average of at least 2.00 in all college credits earned at Iowa State University is required for graduation. Transfer students see Index, Bachelor's Degree Requirements.

General Education

A student must earn at least 70 credits in the areas of learning specified below. The minimum specified are identical for the Bachelor of Arts and Bachelor of Science degrees.

1. ARTS AND HUMANITIES: architecture*, applied art*, design center*, distributed (area) studies, foreign language (civilization, history, literature, linguistics), history, English (literature and linguistics), music, physical education for women (dance), philosophy, speech (theatre) .......................................................... minimum credits: 15

2. COMMUNICATIONS: English (composition and rhetoric), foreign language (composition and rhetoric), journalism and mass communication, library, speech (exclusive of theatre) .......................................................... minimum credits: 15

3. MATHEMATICAL AND NATURAL SCIENCES: bacteriology, biochemistry and biophysics, biology, botany and plant pathology, cell biology, chemistry, computer science, genetics, geology, mathematics, metallurgy, meteorology, physics, statistics, zoology and entomology .......................................................... minimum credits: 20

4. SOCIAL SCIENCES: anthropology, economics, geography, industrial administration, physical education for men (leisure services), political science, psychology, sociology .......................................................... minimum credits: 15

5. HEALTH STUDIES AND PHYSICAL EDUCATION: health studies, physical education for men (exclusive of leisure services), physical education for women (exclusive of dance) .......................................................... minimum credits: none

MINIMUM TOTAL CREDITS: 70

*Refer to the Office of the Dean, College of Sciences and Humanities, for list of approved courses.

The Major

A student must earn from 35 to 70 credits in the major. No credits in the major department or discipline may be included in any general education group. The major shall be chosen from the following list, which also indicates the degree offered in the respective majors. Departments may require more than 35 credits in the major and specify other requirements not stated as college requirements. (See Index for page references to individual departmental and program statements.)


Students may elect a second major from the list above, or from a major field offered for the bachelor's degree in another college of the University. Both major departments must then approve the degree
program. If the two majors lead to different degrees, the student may elect either the B.A. or B.S. degree. Separate degrees may be earned in any combination of two majors. See Index, Bachelor's Degree Requirements.

A special program in international studies is available as a second major to students whose first major is in anthropology, economics, a foreign language, history, journalism and mass communication, philosophy, political science, or sociology. Students with other major programs may be admitted to the international studies major by the chairman of the international studies committee. Students who are interested in international studies should consider the requirements as early as possible in their undergraduate careers, inasmuch as additional credits of specific types are required beyond the normal major. For a complete description of this program see Index, International Studies Program.

The Minor (optional)

If elected, the minor must consist of at least 20 credits, including 100-level courses in the department or the discipline of the minor. Credits in the minor department or discipline may not be included in any general education group. The minor may be chosen from the list of majors given above, or from Air Force aerospace studies, genetics, linguistics (for information, see the Dean, College of Sciences and Humanities), military science, telecommunicative arts, theatre, or from majors offered in other colleges. A minor may include courses from two or more closely related areas if they form a strong and coherent program directed toward a definite educational objective.

English Proficiency

An English minimum proficiency requirement is established by the Department of English. This requirement shall be met by satisfactory completion of one of the following options:

1. English 104 and 105, or the equivalent.
2. English 131 and 132, or the equivalent.
3. A test-out examination for credit to be administered by the Department of English with the department controlling the test procedure and determining those students who are eligible to take the examination.

Speech Proficiency

A speech minimum proficiency requirement is established by the Department of Speech. This requirement shall be met by satisfactory completion of one of the following options:

1. Speech 211, or 322, or 323, or the equivalent of any one of these courses.
2. A test-out examination for credit to be administered by the Department of Speech with the department controlling the test procedure and determining those students who are eligible to take the examination.

Library Proficiency

A library minimum proficiency requirement is established by the library staff. This requirement shall be met by satisfactory completion of one of the following options:

1. Library 160, or the equivalent.
2. A test-out examination for credit to be administered by the library staff who will control the testing procedure and will determine those students who are eligible to take the examination.

Foreign Language

The College of Sciences and Humanities has no uniform foreign language requirement. Any requirements are determined by the respective departments and program committees.

Physical Education

The College of Sciences and Humanities has no uniform requirement in physical education. Requirements are determined by the respective departments and program committees.

The Distributed Studies Program

This program offers the possibility of pursuing somewhat broader studies than the usual major program. (For a discussion of requirements and career opportunities in this program, see Index, Distributed Studies.)

Planning the Program of Study

There is no fixed quarterly schedule of courses required of students in the College of Sciences and Humanities. Each student plans a schedule of courses for each term with guidance from a faculty adviser. Schedules of courses may vary widely in accordance with a student’s major area, special interests, and educational goals.

During the first year, students should meet proficiency requirements in English and in library. Also, they should make substantial progress toward meeting the general education requirement, a large part of which should be completed by the end of the second year. The third and fourth years should emphasize completion of the major and minor (optional) and should give the student opportunity to take electives.

A student is expected to declare a major by the first term of the junior year. Early declaration of a major is usually advantageous for a student in that it permits timely specific planning of the program of study. In the event of an unrealistic choice of major, a change is easily accomplished; however, it may delay the completion of graduation requirements.

A formal degree program listing all courses
taken and those to be taken in fulfillment of the degree requirements must be submitted not later than four terms before graduation. This program must be approved by the department chairman or head of the student’s major department(s) and by the dean of the College of Sciences and Humanities.

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**Curriculum in Music**

This curriculum leads to the degree Bachelor of Music and is an alternative to the curriculum in sciences and humanities with a major in music. At least 192 credits, in accordance with the requirements specified below, must be earned for graduation.

<table>
<thead>
<tr>
<th>Credits</th>
<th>General Education Requirements ..........................................................</th>
<th>71-75</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(Students choosing the music education option will meet the general education requirements of the College of Education.)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>English 104, 105 ...............................................................................</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>Speech 211 .......................................................................................</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Additional English or speech ................................................................</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Physics 198; mathematical, physical, and biological sciences ..........</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>Social science (anthropology, economics, political science, psychology, sociology)</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>History 201, 202, 203 (Western Civilization) ....................................</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>Foreign language (12 credits or 3 quarters in one language) .............</td>
<td>9-12</td>
</tr>
<tr>
<td></td>
<td>Music 355, 356, 357 (History of Music) ...........................................</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>Electives (nonmusic courses) .........................................................</td>
<td>6-13</td>
</tr>
<tr>
<td></td>
<td>Library .........................................................................................</td>
<td>1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Credits</th>
<th>Music core ..................................................................................</th>
<th>71-73</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Music 104, 201, 202, 203, 304, 306, 308, 319 ...............................</td>
<td>29</td>
</tr>
<tr>
<td></td>
<td>Music 119, 219, 319, 419 .................................................................</td>
<td>18</td>
</tr>
<tr>
<td></td>
<td>Two of the following: Music 371, 373, 376, 377, 380, 382, 490D ......</td>
<td>4-6</td>
</tr>
<tr>
<td></td>
<td>Three 3-credit courses in Music 490E, 490C ..................................</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>Ensembles (participation is expected each quarter except during student teaching)</td>
<td>11</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Credits</th>
<th>Music major—Select one of the following options .........................</th>
<th>49-57</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A. History and literature ..............................................................</td>
<td>49</td>
</tr>
<tr>
<td></td>
<td>Music 380, 382, 490D (American Music) ........................................</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>Additional foreign language ..........................................................</td>
<td>9-12</td>
</tr>
<tr>
<td></td>
<td>Electives ......................................................................................</td>
<td>32</td>
</tr>
<tr>
<td></td>
<td>B. Music education .........................................................................</td>
<td>49-57</td>
</tr>
<tr>
<td></td>
<td>Professional education requirements: Educ 204, 205B, Psy 333 ..</td>
<td>9</td>
</tr>
</tbody>
</table>

**Certification options:**

1. Vocal, K-12: (a) Educ 305A, 426; D St 417K; Music 310, 362A, 366, 466A; (b) additional applied music 6 credits; electives 8 credits .................. 40
2. Vocal, K-12: (a) Same as (a) above; (b) C D 226; El Ed 344; D St 417L; 8 credits additional applied music .......................................................... 45
3. Instrumental, K-12: (a) Educ 305A, 426; D St 417K, 417L; C D 226; El Ed 344; (b) Music 119 (minor applied), 362B, 366, 466B, 467, 468, 489, and 4 credits in 387, 388, or 399 .................. 48

<table>
<thead>
<tr>
<th>Credits</th>
<th>C. Organ ..................................................................................</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Music 119B, 219B ........................................................................</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>Music 319C, 419C .......................................................................</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>Music 376, 382, 486, 490F (Materials and Methods of Organ Teaching), 490F (History of Design and Construction of the Organ)</td>
<td>13</td>
</tr>
<tr>
<td></td>
<td>Electives ..................................................................................</td>
<td>24</td>
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<tr>
<td></td>
<td>D. Piano ...................................................................................</td>
<td>18</td>
</tr>
<tr>
<td></td>
<td>Music 119B, 219B, 319B, 419B ......................................................</td>
<td>18</td>
</tr>
<tr>
<td></td>
<td>Music 486, 490F (Master Class in Accompanying and Sight Reading), 490F (Pedagogy and Philosophy of Teaching), 490E (Keyboard Literature) ...........................................................................</td>
<td>16</td>
</tr>
<tr>
<td></td>
<td>Electives ..................................................................................</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>E. String instruments ..................................................................</td>
<td>49</td>
</tr>
<tr>
<td></td>
<td>Music 119B, 219B, 319B ...............................................................</td>
<td>18</td>
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<tr>
<td></td>
<td>Music 181, 321B, 480 ..................................................................</td>
<td>9</td>
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<td></td>
<td>Electives ..................................................................................</td>
<td>22</td>
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<tr>
<td></td>
<td>F. Theory—composition ..................................................................</td>
<td>49</td>
</tr>
<tr>
<td></td>
<td>Applied music .............................................................................</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>Music 362A, 382B, 480, 490B (Calligraphy, Theory), 490C ..........</td>
<td>19</td>
</tr>
<tr>
<td></td>
<td>Electives ..................................................................................</td>
<td>18</td>
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<tr>
<td></td>
<td>G. Voice ....................................................................................</td>
<td>49</td>
</tr>
<tr>
<td></td>
<td>Music 119B, 219B, 319A, 419A ......................................................</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>Music 310, 321A, 480, 490E (Vocal Literature) ............................</td>
<td>20</td>
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<tr>
<td></td>
<td>Additional foreign language .......................................................</td>
<td>9-12</td>
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<tr>
<td></td>
<td>Electives ..................................................................................</td>
<td>6-8</td>
</tr>
<tr>
<td></td>
<td>H. Wind or percussion instrument ................................................</td>
<td>49</td>
</tr>
<tr>
<td></td>
<td>Music 119B, 219B, 319B, 419 .......................................................</td>
<td>18</td>
</tr>
<tr>
<td></td>
<td>Music 367, 369, 369, 467, 468, or 469 ........................................</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Music 486, 490F (Pedagogy in major area, Literature in major area)</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>Ensemble ..................................................................................</td>
<td>1</td>
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<tr>
<td></td>
<td>Electives ..................................................................................</td>
<td>16</td>
</tr>
<tr>
<td></td>
<td>Total for curriculum: 192-209 credits ........................................</td>
<td></td>
</tr>
</tbody>
</table>
The Iowa State University College of Veterinary Medicine includes the departments of Anatomy, Microbiology and Preventive Medicine, Clinical Sciences, Pathology, and Physiology and Pharmacology. The Veterinary Medical Research Institute, the Biomedical Engineering Program, and the Veterinary Medical Diagnostic Laboratory give the student additional opportunities to observe research and diagnostic procedures in veterinary medicine.

A minimum of two years of prescribed preprofessional college work, with a creditable academic average, is required for admission to the professional curriculum in veterinary medicine. Students who wish to receive both the degrees Doctor of Veterinary Medicine and Bachelor of Science take at least three years work in the curricula in agriculture or sciences and humanities. Such a program must have the approval of either the dean of Agriculture or Sciences and Humanities, and the dean of Veterinary Medicine. The professional curriculum extends over a period of four years and leads to the degree Doctor of Veterinary Medicine.

To be awarded the degree Doctor of Veterinary Medicine, candidates must be 21 years of age and of good moral and professional character, have passed all courses in the veterinary curriculum, have at least two quality points per credit in all courses taken in the professional curriculum, and be approved by all departments of the college.

Opportunities for graduates of the College of Veterinary Medicine will be found in practice, educational institutions and industry, in international agencies, federal, state, and local governments, in the armed forces, departments of public health, comparative medicine, laboratory animal medicine and other related fields of professional activity.

Admission Requirements

Applicants for admission to the College of Veterinary Medicine must present a total of not less than 90 quarter credits (60 semester credits) from a regionally accredited college or university. Credits designated below are required and except for electives must have been graded on the traditional four-letter marking system with "A" as the highest mark and "D" as the lowest passing mark. Credits graded "Pass," "Satisfactory," "Test-out" or in a similar manner are not acceptable.

English—8 qr. cr. or 6 sem. cr. (Eng 104, 105)
Speech—3 qr. cr. or 2 sem. cr. (Sp 211)
Chemistry—21 qr. cr. or 14 sem. cr. (Chem 141, 141L, 142, 142L, 211, 334, 336, 337)
Mathematics—5 qr. cr. or 3 sem. cr. (Math 104 or 109 or Stat 104)
Physics—12 qr. cr. or 8 sem. cr. (Phys 111, 112, 113)
Biological Sciences—12 qr. cr. or 8 sem. cr.
   Biology—5 qr. cr. (Biol 101, 101A)
   Zoology—5 qr. cr. (Zool 106)
Genetics—3 qr. cr.
Animal Science—5 qr. cr. or 3 sem. cr. (An S 114)
American Government—3 qr. cr. or 2 sem. cr. (Pol S 215)
Electives—20 qr. cr. or 14 sem. cr. (Excluding credits earned in physical education)
Instruction in the use of the library is prerequisite to admission.

Preveterinary students at Iowa State University enroll in either the College of Sciences and Humanities or in the College of Agriculture. Those enrolled in Sciences and Humanities are advised by the faculty in the College of Veterinary Medicine, and those enrolled in Agriculture are advised by the faculty in the College of Agriculture. A preveterinary student at Iowa State University may elect a 3-year preveterinary program which when combined with the veterinary curriculum will lead to the degree Bachelor of Science in the College of Agriculture or in the College of Sciences and Humanities.

All preveterinary students must have completed at least 45 quarter (30 semester) credits prior to filing an application for admission to the College of Veterinary Medicine. Completed applications with supporting transcripts must be delivered to the Director of Admissions (Room 9, Beardshear Hall) prior to January 15 of the year in which the applicant seeks admission. Transcripts of all high school and college credits must accompany the application. All preveterinary requirements must be fulfilled by the time of filing or scheduled for completion by June 15 of the year in which the applicant seeks admission. A list of courses in progress at the time of filing or scheduled for completion by June 15 should accompany the application and transcripts. Preprofessional college credits must average at least 2.25 on a four-letter marking system. The preceding scholastic requirements are minimum and do not assure admission even though these requirements have been fulfilled.

Because of limited facilities, admission to the College of Veterinary Medicine is on a competitive and selective basis. A preadmission conference with members of the veterinary faculty or other persons designated by the dean is required. High school records, scholastic performance in preveterinary courses, aptitude, character, and personality are given special consideration in the selection of candi-
dates. The College of Veterinary Medicine does not discriminate on the basis of sex, race, color or creed in the admission of individuals to its training programs. 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.

First Year

<table>
<thead>
<tr>
<th>Term</th>
<th>Course</th>
<th>Credits</th>
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<tbody>
<tr>
<td>Fall</td>
<td>Microscopic Anatomy—V An 301</td>
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<td></td>
<td>Gross Anatomy—V An 311</td>
<td>7</td>
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<tr>
<td></td>
<td>Physiological Chemistry—B &amp; B 304</td>
<td>3</td>
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<tr>
<td></td>
<td>Professional Orientation—V M 300</td>
<td>R</td>
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<tr>
<td>Winter</td>
<td>Microscopic Anatomy—V An 302</td>
<td>5</td>
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<tr>
<td></td>
<td>Gross Anatomy—V An 312</td>
<td>6</td>
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<tr>
<td></td>
<td>Physiological Chemistry—B &amp; B 305</td>
<td>3</td>
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<tr>
<td></td>
<td>Comparative Mammalian Physiology—V Phy 349</td>
<td>5</td>
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<tr>
<td></td>
<td>Physiological Chemistry Laboratory—B &amp; B 314</td>
<td>1</td>
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<tr>
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<td>Spring</td>
<td>Microscopic Anatomy—V An 303</td>
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<td>Gross Anatomy—V An 313</td>
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<td></td>
<td>Physiological Chemistry Laboratory—B &amp; B 315</td>
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<td></td>
<td>Comparative Mammalian Physiology—V Phy 350</td>
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Second Year

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<th>Term</th>
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<th>Credits</th>
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<tr>
<td>Fall</td>
<td>General Bacteriology and Immunology—VMPRM 381</td>
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<td></td>
<td>General Pathology—V Pa 371</td>
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<td></td>
<td>Pharmacology—V Phy 367</td>
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<td></td>
<td>Comparative Mammalian Physiology—V Phy 351</td>
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<td>Winter</td>
<td>Pathogenic Bacteriology—VMPRM 382</td>
<td>8</td>
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<td>Veterinary Parasitology—V Pa 376</td>
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<td></td>
<td>Pharmacology—V Phy 366</td>
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<td>Systemic Pathology—V Pa 372</td>
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<td>Spring</td>
<td>Radiology—V C S 381</td>
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<td>Virology and Principles of Epidemiology—VMPRM 383</td>
<td>6</td>
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<td>Veterinary Parasitology—V Pa 377</td>
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<td></td>
<td>Pharmacology—V Phy 366</td>
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<td></td>
<td>General Surgery—V C S 397</td>
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Third Year

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<th>Credits</th>
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<tr>
<td>Fall</td>
<td>Infectious Diseases—VMPRM 431</td>
<td>3</td>
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<tr>
<td></td>
<td>Disturbances of Reproduction—V C S 450</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Clinical Medicine I—V C S 444</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>Special Surgery I—V C S 441</td>
<td>4</td>
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<tr>
<td></td>
<td>Public Health I—VMPRM 434</td>
<td>3</td>
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<tr>
<td></td>
<td>Radiology Laboratory—V C S 446</td>
<td>1</td>
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<tr>
<td>Winter</td>
<td>Infectious Diseases—VMPRM 432</td>
<td>3</td>
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<tr>
<td></td>
<td>Clinical Medicine II—V C S 445</td>
<td>6</td>
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<tr>
<td></td>
<td>Special Pathology—V Pa 422</td>
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<td>Special Surgery II—V C S 442</td>
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<td>Animal Reproduction Laboratory—V C S 447</td>
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<tr>
<td>Winter</td>
<td>Infectious Diseases—VMPRM 432</td>
<td>3</td>
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<tr>
<td></td>
<td>Clinical Medicine III—V C S 449</td>
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<tr>
<td></td>
<td>Special Pathology—V Pa 432</td>
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<tr>
<td></td>
<td>Veterinary Toxicology and Poisonous Plants—V Pa 436</td>
<td>5</td>
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<td>Public Health II—VMPRM 435</td>
<td>3</td>
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<td></td>
<td>Laboratories in Surgery and Surgical Anatomy—V C S and V An 449</td>
<td>3</td>
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<tr>
<td>Fourth Year</td>
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</table>

A minimum of 45 credits must be earned as follows:

1. Required
   - Radiology—V C S 460 .................................................. 33
   - Animal Reproduction—V C S 461 .................................. 1
   - Small Animal Medicine—V C S 462 ................................. 4
   - Small Animal Surgery—V C S 463 .................................. 4
   - Equine Medicine and Surgery—V C S 464 .......................... 4
   - Veterinary Field Services—V C S 465 .............................. 4
   - Interpretive Pathology—V Pa 455 .................................. 3
   - Clinical Microbiology and Public Health—VMPRM 486 ........ 2
   - Seminar—V C S 466 .................................................. R
   - Animal Nutrition—An S 480 ........................................ 6
   - Professional Orientation and Jurisprudence—V M 498 ........ 3

2. Options
   - One or more courses may be chosen from among V C S 460, 461, 482, 483, 464, 465, V Pa 465, and VMPRM 486.

3. Electives ......................................................... 20

Veterinary Medical Societies

All veterinary students are expected to become active members of the Iowa State Student Chapter of the American Veterinary Medical Association. The monthly meetings of the Chapter serve to promote the professional and social development of the members. Students of veterinary medicine may also qualify for membership in the national honor societies of Phi Zeta, Phi Kappa Phi, Alpha Zeta, and Gamma Sigma Delta. Graduate students may qualify for membership in Sigma Xi.

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.
The Graduate College

The Graduate College at Iowa State University is responsible for the quality of graduate education, for administering students' graduate programs by means of individual advisory committees, and for promoting research support from various governmental, industrial, and private agencies. Members of the graduate faculty serve their most important function supervising individual programs of study especially designed for the graduate student's needs.

The graduate faculty consists of the president, the dean of the Graduate College, the vice president for academic affairs, deans of the six colleges, the dean of Library Services, the dean of admissions and records, heads of departments offering graduate work, and members of the faculty who are elected to membership in recognition of accomplishments in their respective disciplines.

Graduate study was offered almost as soon as the University was founded, 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. In 1913, a distinct graduate faculty was organized and an executive graduate committee appointed. In 1915, the graduate faculty held its first meeting and in 1916 it granted the first degree Doctor of Philosophy.

Graduate education is vital to the quality of university teaching. The creative efforts of graduate faculty members and graduate student result in knowledge necessary to help society solve problems in educational, scientific, technological, and socioeconomic areas. The graduate college encourages educational exchange and contact with undergraduate areas of the University to promote improved teaching on both the undergraduate and graduate level. A part of this exchange is accomplished by books and technical articles which are made possible by graduate research.

The degrees Master of Arts, Master of Science and Doctor of Philosophy are research oriented, although in certain fields the degree Master of Arts and the degree Master of Science are also available without thesis. For those persons interested in advanced study directed more particularly toward meeting vocational or professional objectives, the degrees Master of Architecture, Master of Education, Master of Engineering, and Master of Landscape Architecture are offered.

Graduate Appointments

Graduate assistantships, industrial fellowships, and certain special research grants have been established at Iowa State University for the encouragement of graduate work and the promotion of research. Such appointments and research opportunities are available through the various departments of instruction, the Agriculture and Home Economics Experiment Station, the Engineering Research Institute, the Home Economics Research Institute, the Sciences and Humanities Research Institute, the Statistical Laboratory, the Computation Center, the Institute for Atomic Research, the Veterinary Medical Research Institute, and the Office of the Vice President for Research.

Graduate assistantships permit the holder to enroll for two-thirds of a full schedule, or 11 credits per quarter. Recipients of these assistantships are exempt from payment of other fees except for $120 per quarter. A graduate assistant is expected to give half-time service to the teaching or research projects of his department. These appointments are open to students who have graduated from approved colleges in the highest quartile of their respective classes and who present the requisite undergraduate or graduate preparation. Students registered on a restricted or nondegree basis and those placed on academic probation are not eligible for assistantship appointment. Further information may be obtained by writing to the department head concerned or to the dean of the Graduate College.

Fellowships and traineeships supported by the National Science Foundation, the Public Health Service, the United States Office of Education, and other agencies of the federal government are offered. 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, plus satisfactory academic performance, will ordinarily make a student eligible for reappointment.

Post Doctoral Study

Opportunities are provided for postdoctoral study through the extensive research programs of the University. Inquiries should be directed to the appropriate institute or to the dean of the Graduate College.

Graduate Study by Members of the Staff

Any full-time member of the research, instructional, or extension staffs of the rank of instructor, associate, or junior scientist, subject to the approval of the head of his department or section, may carry not more than 5 credits of graduate work per quarter, provided such does not interfere with his other duties. This privilege may be extended to members of the research, instructional, or extension staffs
of the rank of assistant professor upon approval of the college dean concerned and the dean of the Graduate College.

Staff members holding the rank of professor or associate professor cannot become candidates for degrees from this institution.

Admission

A prospective student is invited to correspond with the head of the department in which he or she wishes to study for information concerning graduate study in that academic discipline.

Application blanks are available from the Office of Admissions, 9 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.

Full Admission. An applicant who is a graduate of an institution in the United States whose requirements for the bachelor's degree are substantially equivalent to those at Iowa State University, and who ranks in the upper one-half of his class, may be admitted to the Graduate College, if recommended by the department head and approved by the dean of the Graduate College. Admission does not constitute acceptance as a candidate for a degree.

Full 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.

Nondegree admission. An applicant who is a graduate of an accredited university in the United States may be granted nondegree admission when the student wishes: (1) to transfer graduate credit earned at Iowa State University to other institutions; (2) to enroll occasionally in off-campus graduate courses; or (3) to take graduate courses without pursuing an advanced degree.

Transfer from nondegree admission to full admission requires the submission of complete academic records and recommendation by the department head and the approval of the graduate dean.

For those students admitted to the Graduate College for nondegree study, no more than 12 hours of graduate credit earned under the nondegree option may be applied if the student later chooses to under-

take a degree option. The student's advisory committee will recommend which courses, if any, taken on a nondegree basis may be included in the program of study.

Medical Examination. Upon entering Iowa State University, each graduate student is required to have a physical examination which must include a tuberculin test and/or chest x-ray taken within the past year. Students accepted for admission will be sent forms to be completed by a personal physician who should return them promptly to the University Hospital. Registration will not be permitted until this requirement has been met.

Graduate Record Examination. No uniform examination is currently required of all applicants for admission.

English Requirement. At the time of admission, the student's department indicates his status with regard to a qualifying examination in English. Students who fall into the following categories are routinely excused from examination: (1) Any student who has received his bachelor's degree no more than two years prior to his entrance into Iowa State, and either has completed an undergraduate English composition sequence with no grade lower than C, or has passed during his undergraduate career an English examination which tests the ability to communicate in writing (similar to the ISU English Proficiency Examination), (2) Any student who has written a master's thesis in the English language which has been accepted by an accredited college or university. Individual departments may establish more stringent requirements and will also decide the necessity of an English examination where the student's transcript does not indicate grade level in English, as in the case of P or S grades.

Students required to take an English qualifying examination must do so before completing 11 credit hours of graduate work at Iowa State University. In the event that a graduate student fails the examination, he must take appropriate remedial action including the writing of at least one practice paper at the Writing Clinic for which the Writing Clinic staff will provide a critique. Ordinarily, two additional trials are allowed, but each must be preceded by remedial action. Trials beyond three will be permitted only upon petition by the department head or chairman and approval of the graduate dean.

Foreign Students

Except by special petition to the graduate college, supported by substantial evidence, graduates of recognized universities located outside the United States may be granted restricted admission only.

Foreign students are required to carry adequate health and accident insurance while in residence.

Graduate students whose native language is not English take a special examination administered by the Department of English in lieu of the standard qualifying examination.
Foreign students registered on a restricted or nondegree admission basis and those placed on probation, are not eligible for assistantship appointment.

Registration

Planning Graduate Study. Scholastic competence, independence and maturity of thought should have dominance over other objectives of graduate study. Students must accept responsibility for their 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 them confidence in their own judgments. As soon as possible, in conference with the head of the department, the student should select a major professor and advisory committee and in consultation with them outline a 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, is 16 credits. Schedules for graduate assistants are limited to a maximum of 11 credits; for full-time staff members, to 5 credits.

Graduate students (even though course and residence requirements have been met) must register in any quarter in which the facilities of the institution or staff time are being used, including preparation of thesis or dissertation, or preparation for examination. The number of credits under these circumstances shall be consonant with the amount of work done, laboratory facilities used, and staff direction involved.

Interim Registration. Registration for special work between quarters and during certain vacation periods cannot exceed 1 credit for each week that the student is in residence. The fee is $29 per credit for residents and $50 per credit for nonresidents.

"In Absentia" Registration. Graduate work by correspondence is not permitted, nor is it accepted in transfer. In exceptional cases, the Graduate Committee may authorize registration in absentia. Generally such registration is restricted to thesis preparation after completion of research or for research under special conditions. The total credit thus obtained cannot be used to reduce residence requirements.

Extension and Off-campus Registration. Many departments offer off-campus classes which are taught by members of the university graduate staff. For this purpose special arrangements are made for the necessary library and laboratory resources so that the classes are equivalent to those taught on campus.

Auditing. Courses may be audited upon recommendation of the student's major professor. Each audited course will reduce the permitted credit load by one, but fees will be assessed on the basis of catalog credit.

Graduate Courses Taken by Seniors. Certain graduate level courses listed in the General Catalog may be taken for graduate credit by undergraduate seniors. If a student is admitted for graduate study at Iowa State University, the advisory committee at the time the program of study is submitted may request approval from the graduate dean that up to 12 hours of such credit be applied toward meeting advanced degree requirements. Credits earned in these courses must be in addition to those used to meet requirements of the bachelor's degree.

Special Regulations for Students in Veterinary Medicine. Specially qualified advanced students in Veterinary Medicine may request permission from the dean of the College of Veterinary Medicine and the dean of the Graduate College to pursue work coincidentally toward the degree of Master of Science and Doctor of Veterinary Medicine.

In order for a student to participate in such a concurrent program, he or she must be admitted to the Graduate College and an advisory committee must be appointed according to the usual procedures. A program of study must be submitted to the Graduate College and the College of Veterinary Medicine for approval prior to the accumulation of more than 12 hours of graduate credit.

Degree Requirements

A Graduate Student Handbook is available in the University Book Store. Each new graduate student is urged to obtain a copy.

Probation. Students must maintain an average of "B" on all work taken in the Graduate College to remain in good standing. A student may be placed 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 College. Students will not be admitted to candidacy while on probation. Generally registration beyond the third quarter will be refused to a student whose quality of work is unsatisfactory.

Time Limit. It is expected that work for the master's degree shall be completed within a term of three years or five summer quarters. For the doctorate, work shall be completed within a term of five years. Only upon recommendation of a student's advisory committee and with approval by the dean of the Graduate College, is credit allowed for courses taken over a period of more than five years.

Master of Science and Master of Arts

A student becomes eligible for candidacy after completing one quarter's work with a "B" average. General requirements for the degree are as follows:

Appointment of the Student's Advisory Committee. Following enrollment in the Graduate College and as soon as practicable thereafter, the department head or chairman shall recommend to the dean of the
Graduate College a committee of the graduate faculty to be in charge of the student's work.

This committee shall consist of at least three members of the graduate faculty, one of whom must come from a different department. It is recommended that at least one of the committee be a full member of the graduate faculty, particularly if the other members of the committee are relatively new members of the Iowa State faculty. An associate member of the graduate faculty may serve as major professor for a Master's degree candidate. A faculty member holding a joint appointment may not serve as an "outside the department" member on a committee if the student's major is in either of the departments represented in the joint appointment.

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: There is no on-campus residence requirement for the Master's degree.

Credits. At least 45 credits of acceptable graduate work must be completed, not less than 33 of which must be earned from 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. The exact number of credits in major is not prescribed. To obtain the specialization which is considered essential for an advanced degree, approximately two-thirds of the work should be devoted to the major field, but this is not necessarily restricted to one department. A formal minor may be declared but will require approval by the minor department.

A graduate student may not change from one major to another without written permission from the head of the department or departments and approval from the dean of the Graduate College.

Foreign Languages. There is no uniform requirement for the Graduate College. Please see the departmental descriptions in this catalog for details.

For those departments wishing to utilize them and for students interested in transferring a foreign language test score elsewhere, the University offers the standardized examinations provided by Educational Testing Service.

For students whose native language is not English, the ability to communicate adequately in English (certified by the Department of English) may be acceptable as a substitution for the reading knowledge of one foreign language. This option will apply only when specifically recommended by the student's advisory committee.

The foreign language requirement, where applicable, may not be met in the quarter in which the student will receive his degree.

Application for Graduation. Application for graduation must be made by mid-term of the quarter preceding the quarter in which the student expects to receive the degree. This requires the presentation of an approved diploma slip to the Office of the Graduate Dean.

Thesis. A thesis is required in all areas in which the M.S. or M.A. is granted, except where specific provision is made for a nonthesis degree program. Joint authorship is not permitted. Copies of the completed thesis must be in the hands of the examining committee and the Thesis Office for approval two weeks prior to the date fixed for the final examination. After the final examination, two unbound approved copies of the thesis shall be deposited with the Thesis Office, University Library. These copies of the thesis must be deposited not less than two weeks prior to commencement. A charge of $25 will be made to cover library costs and title publication in the Iowa State Journal of Research.

The student should consult The Graduate College Thesis Manual, prepared for the use of students in the Graduate College, before arranging for the typing of his thesis.

Final Examination. After all other requirements have been met, the final examination shall be taken on all graduate work, including the thesis where applicable. It will ordinarily be oral, but may be written in whole or in part, as determined by the committee in charge.

Graduation Approval Slip. These slips are prepared by the Office of Student Records about two weeks prior to the end of a quarter. Candidates wishing to secure this form at any earlier date should file a request with the Office of the Graduate Dean at least three days prior to the time the form is needed.

Master of Science and Master of Arts—Nonthesis

In certain authorized departments where research specialization does not best meet the professional needs of the student, a nonthesis degree program may be undertaken. This will require satisfactory completion of at least 45 quarter hours of acceptable credits (not including research credit) and satisfactory completion of a comprehensive examination. Detailed requirements may vary with fields. Reference should be made to the departmental descriptions in this catalog.

Master of Architecture

For the degree Master of Architecture, a minimum of 90 credits beyond the degree Bachelor of Arts or a minimum 45 credits beyond the degree Bachelor of Architecture is required.
Master of Education

For the degree Master of Education, a minimum of 52 credits will be required, provided all credits are in graduate level courses. A minimum of 15 credits must be earned in course work outside the major. No foreign language is required. A field study is written in lieu of a thesis.

Master of Engineering

The academic standards and the general level of attainment are the same for the Master of Engineering and Master of Science degrees. Master of Engineering programs are intended to be more flexible in their educational objectives, and they are offered to meet the expanding needs for off-campus graduate engineering programs at locations with adequate library and laboratory facilities, and for special situations of professionally oriented programs on campus.

General requirements for the degree Master of Engineering are the same as those for the degree Master of Science. No foreign language is required. Upon recommendation of the student’s committee, the thesis requirement may be waived. Choice of this option requires the completion of an additional 7 credits of acceptable graduate work.

Of the minimum credit requirement of 45, 33 credits must be received from Iowa State University

Master of Landscape Architecture

The degree Master of Landscape Architecture requires a minimum of 60 graduate credits and the satisfactory completion of a thesis or a terminal project.

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 preparation in related courses.

Appointment of the Student’s Advisory Committee. Following enrollment in the Graduate College, and as soon as practicable thereafter, the department head or chairman shall recommend to the dean of the Graduate College a committee of the graduate faculty to be in charge of the student’s graduate program. This committee shall consist of the following: At least five members of the graduate faculty, three of whom must be full members. At least two committee members must be outside the declared major or area of specialization, and at least one of these must be outside the department. A faculty member holding a joint appointment may not serve as an “outside the department” member on a committee if the student’s major is in either of the departments represented in the joint appointment. An associate member of the graduate faculty may not serve as major professor of a doctoral program but may serve as a co-chairman, if the department head/chairman requests this by an explanatory memorandum accompanying the “Recommendation for Committee Appointment.”

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 108 graduate credits must be earned for a Ph.D. At least 54 credits including all dissertation research credits must be earned in residence at Iowa State University. 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.

At least 36 credits of residence study must be earned in quarters other than summer quarters.

Major and Minor. A major is the area of study or academic concentration approved by the Board of Regents in which a student chooses to qualify for the award of a graduate degree. Majors are listed for departments and interdepartmental programs in the Courses and Programs section of the catalog. (See Courses and Programs)

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.

Courses for minor credit are also listed by departments or interdepartmental programs. (See Courses and Programs.) Formal minors may be declared in which case the student must meet certain minimum requirements established by the department administering the minor.

Foreign Languages. There are no uniform requirements for the Graduate College. Please see the departmental descriptions in this catalog for details.

For those departments wishing to use them and for students interested in transferring a foreign language test score elsewhere, the University offers the standardized examinations provided by the Educational Testing Service.

For students whose native language is not English, the ability to communicate adequately in English (certified by the Department of English) may be acceptable as a substitution for the reading knowledge of one foreign language. This option will apply only when specifically recommended by the student’s advisory committee.
The foreign language requirement, when applicable, may be fulfilled at any time, but not less than six months prior to the final examination.

Preliminary Examination. The student must pass satisfactorily a preliminary examination before being granted advancement to candidacy for the degree. This examination is comprehensive and should not be restricted only to the content of graduate courses. It usually has two parts: a written examination followed by an oral examination. The oral examination is mandatory, and all members of the student's doctoral committee (or approved substitutes) must be present. The preliminary examination is usually given before all course work has been completed, and must be passed at least six months 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 dean.

Diploma Slip. A diploma slip must be filled out and returned by midterm of the quarter preceding the quarter in which the student expects to receive the degree.

Dissertation. A doctoral dissertation shall be completed on some topic connected with the major field. To be acceptable it must constitute a significant contribution to knowledge. Joint authorship is not permitted.

Copies of the completed dissertation must be in the hands of the examining committee and the Thesis Office for approval two weeks prior to the date fixed for the final examination. After the examination, and at least two weeks prior to commencement, two complete and approved copies of the dissertation shall be deposited with the Thesis Office, University Library.

At the same time the dissertation is deposited, two typewritten copies of an abstract which meet the requirements as set forth in The Graduate College Thesis Manual must also be filed with the Thesis Office, University Library. A charge of $50 will be made to cover library costs, microfilming of the dissertation, and publication of a 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 after submission of the dissertation and the completion of all other work prescribed for the degree. This examination shall be oral and may be both written and oral if specified by the student's committee. It is intended principally as a defense of the dissertation.

Graduation Approval Slip. These slips are prepared by the Office of Student Records about two weeks prior to the end of a quarter. Candidates wishing to secure this form at any earlier date should file a request with the Office of the Graduate Dean at least three days prior to the time the form is needed.
Courses and Programs

Definition of a Credit

The value of each course is stated in quarter credits. A one-credit course requires one recitation involving two hours of preparation or one three-hour laboratory period or other combination of teacher-student contact and outside preparation involving a total of three clock hours per week for 11 weeks. The abbreviation "Cr. R." in a course description indicates that the course is required but no credit is given.

Course Numbers

The courses in each department are numbered from 1 to 599, according to the following groups:

1-99 — Courses not carrying credit toward a bachelor's degree.
100-299 — Courses primarily for freshman and sophomore students.
300-499 — Courses primarily for junior and senior students.
500-599 — Courses primarily for graduate students, but open to qualified undergraduates.
600-699 — Courses for graduate students only.

The value of each course is stated in quarter credits. After the title of each course are two numbers in parentheses. Generally, the first number indicates the number of lecture and recitation hours a week and the second, the number of laboratory hours per week. However, there may be other combinations of teacher-student contact and outside preparation totaling approximately three clock hours per week per credit for a quarter.

Within 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 1974" identifies courses to be available during winter quarter of the 1973-74 academic year. The abbreviation "Yr." is used to designate a sequence of three courses taught fall, winter, and spring, respectively. If there is sufficient demand, courses may be offered more frequently than announced.

Course Prerequisite

A statement to indicate the background in a subject matter field or the academic maturity suggested so that a student can be ready to undertake the course. Specific courses as prerequisites are usually listed but it is understood the equivalent preparation is satisfactory. It is the instructor's prerogative to waive prerequisites at any time in courses for which he is responsible. Thus, permission of instructor is understood to be an alternate to other prerequisites in all courses.

Graduate Major

A major in the Graduate College is the area of academic professional concentration, approved by the Board of Regents, in which the student chooses to qualify for the award of a graduate degree.

Graduate Area of Specialization

Areas of specialization are indicated in the graduate statements of some departments. This is a subdivision of a major in which a strong graduate level program is available. When approved by the Graduate College, such areas of specialization are shown parenthetically after the major on official records and transcripts.

Interdepartmental Programs

Interdepartmental programs are available at both graduate and undergraduate levels. An interdepartmental program is an administrative structure usually not functioning as a department, ordinarily headed by an advisory committee, and offering a degree with major(s) in that subject area. Interdepartmental programs have been officially approved and may offer courses.

Aerospace Engineering

R.F. Brodsky, Head of Department

Professors: Ernest W. Anderson, Hsu, Iversen, Millett, Peterson

Associate Professors: Dale A. Anderson, Hermann, Pierson, Stuve

Assistant Professors: James, Lunde, Seversike, Tannehill, Instructor: Holst
Undergraduate Study

For undergraduate curriculum in aerospace engineering leading to the degree Bachelor of Science, see College of Engineering, Curricula.

The aerospace engineer is primarily concerned with the design, analysis, testing, and operation of vehicles which operate in an atmosphere, a fluid medium, or free space as well as on the water and land surfaces. The curriculum is designed to provide the student with an education in the fundamental principles of aerodynamics, flight mechanics, propulsion, structural mechanics, controls, design, testing, space, and hydrospace technology. Programs of study are available to the student that lead either to a general systems background in these topics or to specialization in any of the above mentioned areas, flight safety, manned and unmanned space-flight, surface transportation, and nontraditional aerospace applications, such as atmospheric science, storm phenomena, and the aerodynamics of buildings. A wide variety of opportunities await the aerospace engineering graduate in research, development, design, production, sales, and management in the aerospace industry, and in many related industries in which fluid flow, control, and transportation problems play a major role.

A cooperative work-study program in aerospace engineering is available in conjunction with several industries and governmental concerns. The usual four-year curriculum is extended over a five-year span to permit alternate industrial experience periods and academic periods. This arrangement offers valuable practical experience and financial assistance during the college years. See College of Engineering, Cooperative Programs.

Graduate Study

The department offers work for the degrees Master of Engineering and Master of Science with major in aerospace engineering, and minor work to students taking major work in other departments. Work may be taken for the degree Doctor of Philosophy as a co-major with other departments offering work in related fields for this degree. No foreign language is required for the degrees Master of Engineering, Master of Science, and Doctor of Philosophy. However, the completion of a minimum of 9 credits of additional course work not directly related to the major is required for the degree Doctor of Philosophy. These courses are intended for the cultural enrichment of the student and are subject to the approval of the student’s committee. Prerequisite to major graduate work is the completion of a curriculum substantially equivalent to that required of undergraduate students in aerospace engineering at this institution.

Open to graduate students for minor credit only: 309, 320, 321, 343, 344, 352, 411, 413, 415, 420, 421, 431, 432, 433, 441, 442, 443, 445, 446, 452, 453, 455, 456, 461, 462, 463, 469, 480.

Courses Primarily for Undergraduate Students

100. Technical Lecture. (1-0) Cr. R; S. Orientation in the field of aerospace engineering.

240. Introduction to Aerospace Engineering. (1-3) Cr. 2. F. Prerequisite: Math 132 or 132, Phys 221. Historical developments in aeronautics and astronautics. How certain aviation problems have been solved using design principles.

244. Aerodynamics I. (3-0) Cr. 3. F. Prerequisite: Math 122 or 132, Phys 221. Fundamentals of aircraft performance, incompressible aerodynamics, and the concepts of mass, momentum, and energy.

245. Aerodynamics II. (3-0) Cr. 3. W. Prerequisite: 244. Airspeeds and wing nomenclature. Nature and theory of aircraft forces and moments. Introduction to viscous and compressibility effects.

246. Performance of Aerospace Vehicles. (3-0) Cr. 3. S. Prerequisite: 245. Performance of aerospace vehicles.

271, 272. Aerospace Laboratory. (0-3) Cr. Each W.S. Prerequisite: 271: Credit or classification in 245, 272: Credit or classification in 246. Practical application of aerospace principles and concepts through laboratory experiments.

300. Inspection Trip. Cr. R; S. Prerequisite: Junior aerospace engineering classification. Inspection trips 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.


340. Introduction to Aerodynamics. (3-0) Cr. 3. W. Prerequisite: Math 223 or 233. Aerodynamics of flight vehicles. For nonaerospace engineering majors.


344. Stability and Control II. (3-0) Cr. 3. W. Prerequisite: 343, E M 346. Dynamic stability and control of flight vehicles.

352. Flight Mechanics I. (3-0) Cr. 3. S. Prerequisite: Math 321, E M 345. Introduction to aerodynamics, launch vehicle trajectories, Keplerian motion, coordinate systems, and atmospheric entry.

371, 372, 373. Aerospace Laboratory. (0-3) Cr. Each F. W.S. Prerequisite: 371; 346, 372: Credit or classification in 320, 344, 373: Credit or classification in 309, 321. Practical application of aerospace principles and concepts through laboratory experiments.

411. Reaction Propulsion II. (3-0) Cr. 3. F. Prerequisite: 309. Turb, fan, turboset, turboprop, ramjet, and rocket propulsion system principles.

413. Reaction Propulsion III. (3-0) Cr. 3. W. Prerequisite: 411. Combustion in rocket engines, solid rocket fuels, hardware needs for liquid fuel rockets, nuclear and ion propulsion devices.

415. Reaction Propulsion IV. (3-0) Cr. 3. S. Prerequisite: 413. Exotic space propulsion systems. Unsteady performance, dynamics, and control of turbo-engines. Blade element theory as applied to propellers and axial flow compressors, turbines, and fans.

420, 421. Advanced Flight Structures Analysis and Design I, II. (3-0) Cr. Each 420: W.; 421: R. Prerequisites: 420, 321, 412, 420. Selected topics in the strength, stability, and deflection analysis of common aircraft, missiles, and spacecraft structures; such as monocoque and semimonocoque, thin-skinned pressure vessels and shells, wings, solar panels, columns, hot structures, and others. Typical design problems are detailed.
Courses and Programs


432. Flight Control Systems. (3-0) Cr. 3. W. Prerequisite: 431. Application of automatic control concepts to the problems associated with the control of aerospace vehicles.

432. Flight Systems Testing. (0-6) Cr. 3. S. Prerequisite: 432. Application of instrumentation to flight systems. Reduction and analysis of experimental data as obtained from aerospace systems. Aircraft, missile, and satellite testing.

441. Aerodynamic Theory I. (3-0) Cr. 3. F. Prerequisite: 309. Introduction to classical theory of compressible and incompressible fluids. Shock and expansion waves.

442. Aerodynamic Theory II. (3-0) Cr. 3. W. Prerequisite: 441. Principles of compressible and incompressible flow. Application to aircraft, wings, and solid of revolution.


445. 446. Aerospace Vehicle Performance. (2-0) Cr. 3 each. 445: W. 446: S. Prerequisite: 445: 344; 446: 445. Introduction to the aerodynamics, performance, stability, control, and critical maneuvering characteristics of aerospace vehicles such as V/STOL aircraft, helicopters, hovercraft, and other short-range transportation vehicles.


455. 456. Introduction to Hyperspace Engineering. (Geol 455, 456) (3-0) Cr. 3 each. W. S. Prerequisite: 455: Math 213, Phys 223; 456: 344, 445. Introduction to elementary hyperspace vehicle performance, stability and control, and physical oceanography. Application of hyperspace principles to motion of vehicles under, on, or above the surface and instrumentation for hyperspace research.

461. Design and Analysis II. (3-0) Cr. 3. F. Prerequisite: Senior classification. Concepts of systems design as related to aerospace problems.

471, 472, 473. Senior Projects. (0-3) Cr. 1 each. F.W.S. Prerequisite: 471: Credit or classification in 411, 431, 441; 472: 471; 473: 472. Development of aerospace principles and concepts through individual projects.


490. Special Problems. Arr. Cr. 1 to 6. Prerequisite: 344.
A. Aero and/or Gasdynamics.
B. Propulsion.
C. Stress Analysis.
D. Flight Mechanics.
E. Flight and Space Systems.
F. Hydrospace.
G. Aeroelasticity.
H. Honors.
I. Design.
J. Hypersonic Testing.
K. Model Towing Basin Testing.

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.


541, 542, 543. Advanced Aerodynamics. (M E 541, 542, 543) (3-0) Cr. 3 each. Yr. Prerequisite: 441. Classical flow theory, compressible fluid theories, shock wave studies, and applications to aerodynamic shapes.

544. Advanced Aerodynamics. (3-0) Cr. 3. F. Prerequisite: 543. Applications of classical flow theory, compressible fluid theories, and shock wave studies to aerodynamic shapes.


552. Performance Analysis. (3-0) Cr. 3. S. Prerequisite: 550. Use of energy methods and optimization in the performance analysis of high performance, supersonic, and hypersonic vehicles.

561. Airframe Design and Analysis. (3-0) Cr. 4. F. Prerequisite: 421. Numerical and approximate methods utilized in the static and dynamic design and analysis of typical airframes. Theory and applications to design problems of aircraft, missiles, and spacecraft. Structural dynamics problems will be emphasized.

590. Special Topics. Cr. 1 to 5.
A. Aero and/or Gasdynamics.
B. Propulsion.
C. Stress Analysis.
D. Flight Mechanics.
E. Flight and Space Systems.
F. Magnetofluidodynamics.
G. Hydrospace.
H. Viscous Aerodynamics.
I. Design.
J. Hypersonic Testing.
K. Model Towing Basin Testing.
L. Hypervelocity Testing.
M. Computational Aerodynamics.
N. Severe Storm Technology.

Courses for Graduate Students, major or minor

610, 611. Aeroelasticity. (3-0) Cr. 3 each. 610: Alt. W.; 611: Alt. S. offered 1974. Prerequisite: 644, E M 444 or equivalent. Interaction of aerodynamic, elastic, and inertial forces and the influence of this interaction on airplane design. Steady and unsteady aeroelastic problems.

615, 616. Optimization in Aerospace Engineering. (3-0) Cr. 3 each. 615: Alt. W.; 616: Alt. S. offered 1975. Prerequisite: 543, 551. Applications of calculus of variations, method of gradients, dynamic programming, and other optimization techniques to problems in aerodynamics, flight mechanics, design, etc.

620. Seminar. (1-0) Cr. 1.

Agricultural Business

For courses in agricultural business, see Economics, Courses and Programs.

Agricultural Education

Harold R. Crawford, Head of Department

Professors: Bundy, Crawford, Holmes, Lawrence, McClelland.
Associate Professor: Hoerner.
Assistant Professors: Byler, Kahler.
Instructors: Carter, Hobeg.

Undergraduate Study

For undergraduate curriculum in agricultural education leading to the degree Bachelor of Science, see College of Agriculture, Curricula.

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

Graduate Study

The department offers work for the degrees Master of Science, Master of Education, and Doctor of Philosophy with major in Agricultural Education and minor work to students taking major work in other departments.

Prerequisite to major graduate work in agricultural education is preparation substantially equivalent to the completion of the undergraduate curriculum in agricultural education offered at Iowa State University, and adequate proof that the student ranks above average in scholastic ability and promise of vocational competency.

A foreign language is not required for the Master of Science, Master of Education, or Doctor of Philosophy degrees.

Off-campus courses are offered for professional personnel in the field. Three-week courses are offered during the summer sessions for vocational agriculture and agricultural extension personnel.

Courses Primarily for Undergraduate Students

110. Orientation in Agricultural Education. (1-0) Cr. R; F.W.

211A, 211B: Observation and Survey of Program of Education in Agriculture. (1-3) A: F.S., Cr. 2; B: F.S., Cr. 1. 211A: Agricultural Education. Individual observation and survey of programs in agriculture. Field trips. 211B: 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.

290. Special Problems in Agricultural Education. Cr. 1 to 3.

310. Seminar in Agricultural Education. (1-0) Cr. 1. Satisfactory-fail. F.W.S. Prerequisite: Junior classification.

321. Planning Programs in Vocational Agriculture. (2-3) Cr. 3. F.W.S. Prerequisite: Educ 305. Organization and analysis of vocational agriculture programs with emphasis on occupational experience programs, summer programs and FFA activities.
Courses for Graduate Students, major or minor

604. Evaluation and Program Planning in Agricultural Education. (3-0) Cr. 3. F.W.S. Prerequisite: Fifteen credits in education. Criteria and procedures for evaluation of programs in agricultural education. Adoption and implementation of evaluation results in program organization, administration, and content.

615. Seminar in Agricultural Education. (1-0 to 3-0) Cr. 1 to 3. F.W.S.S.S.


660. Research.

Agricultural Engineering

Clarence W. Buckhop, Head of Department
Professor: Beer, Beresford (Emeritus), Buchele, Charity, Giese, Hazen, Hukill, Hull, Johnson, Morford (Emeritus), Pedersen.
Associate Professor: Hoerner, Kline, Lovely, Mangold, Marley, Meyer, Palmer, Roth, Saul, Soderholm, Van Fossen.
Assistant Professor: Anderson, Hansen, Melvin, Smith, Vanderholm.
Instructors: Ayres, Bern, Bettis, Boyd, Glim, Hanson, Hoof, Van Ee.

Undergraduate Study

For the undergraduate curriculum in agricultural engineering leading to the degree Bachelor of Science, see College of Engineering, Curriculum.

The curriculum in agricultural engineering provides training in the major fields of engineering applications to the industry of agriculture. Graduates from the curriculum find employment in agricultural production enterprises, in industries which supply goods and services to agriculture, and in the state and federal agencies responsible for agricultural engineering research, application, and education.

Employment for agricultural engineers is available in many agricultural industries. Professional services performed in the farm-equipment industry include engineering design, development, manufacturing, product education, and sales. Services are rendered to industries supplying farm building materials.
and equipment, and in the design, construction, merchandising, and contracting of farm buildings. Students may also prepare for employment in design, development, construction, sales, and service in the areas of soil erosion control, drainage, and irrigation; rural electrification; crop processing and storage; and materials handling in agriculture.

The department has cooperative programs established for interested and qualified students. The four-year curriculum is extended over a five-year period and interspersed with work periods at cooperating organizations. This plan offers valuable practical experience and financial assistance during the years in college.

The department offers an undergraduate curriculum in agricultural mechanization, see College of Agriculture, Curricula. The agricultural mechanization courses are offered for students in the College of Agriculture. These courses include areas of agricultural mechanics, soil and water management, power and machinery, electric power, farm buildings, animal environment, crop storage and conditioning, and agricultural safety.

### Graduate Study

The department offers work for the degrees Master of Science, Master of Engineering, and Doctor of Philosophy with major in agricultural engineering and minor work to students taking major work in other departments. Minor work is also offered in agricultural mechanization for students in the College of Agriculture, see Agricultural Mechanization. Within the major the student may specialize in soil and water resources, field power and machines, materials handling, crop conditioning and processing, agricultural structures and environment, and animal waste management.

Prerequisite to major graduate work is the completion of an undergraduate curriculum substantially equivalent to that required of agricultural engineering undergraduate students at this institution.

A foreign language is not required for the degree Master of Science or Master of Engineering. The language requirement for the degree Doctor of Philosophy may be satisfied by one of three ways: (1) Demonstrate a satisfactory reading knowledge of two foreign languages approved by the department. (2) Demonstrate a significantly higher degree of communication competence for one foreign language. (3) Demonstrate a satisfactory reading knowledge of one foreign language and scholarly achievement in a minimum of 9 credits of course work in the social sciences and humanities.

The department also participates in the interdepartmental program of water resources. (See Water Resources.)

Open to graduate students for minor graduate credit only: 346, 377, 424, 425, 434, 435, 436, 437, 461, 464, 465, 471, 477.

### 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.

230. Agricultural Engineering Concepts I. (3-3) Cr. 4. F. Prerequisite: Credit or classification in Phys 122 or 132 and Phys 221. Introduction to concepts of energy and mass flow. Analysis of the atmospheric environments. Aspects of agricultural hydrology. Effects of environment on plants, animals, and crops.


301, 302, 303. Seminar. (1-0) Cr. R. Yr. Preparation, presentation, and discussion of papers on agricultural engineering subjects.

346. Agricultural Tractor Power. (3-3) Cr. 4. S. 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 carburation, ignition, Rating and testing of tractors.


401, 402, 403. Seminar. (1-0) Cr. R. Yr. Preparation, presentation, and discussion of papers on agricultural engineering subjects.


438. Agricultural Machinery Design II. (0-6) Cr. 2. S. Prerequisite: 435, M E 421. Design, development, and testing of farm machinery to meet the functional requirements of machines for tillage, seeding, cultivation and weed control, harvesting, crop processing, and farm power units.

437. Power and Control Hydraulics. (2-2) Cr. 3. F. Prerequisite: Credit or classification in E M 378. Significance of hydraulic fluid properties. Performance parameters for fixed and variable displacement pumps and motors.
Courses for Graduate Students, major or minor


661, 662, 663. Seminar. (1-0) Cr. 1 each. Yr. Discussion of research problems, methods, procedures, and reports.


699. Research.

Courses Primarily for Graduate Students, major or minor, open to qualified undergraduates


531. Design Criteria for Agricultural Structures. (3-0) Cr. 3. S. Prerequisite: 377. Development of physical and environmental design criteria essential to buildings and related equipment used in the production of livestock and storage of crops. Research needs and techniques.


533. Agricultural Power and Machinery. (3-0) Cr. 3. F. Prerequisite: 346 or 434. Critical analysis of power and equipment for agricultural production with emphasis on functional design requirements, and techniques for testing and evaluating performance.

534. Advanced Farm Electrification. (3-0) Cr. 3. S. Prerequisite: 461. Critical analysis of electric power, heat, light, and controls in agricultural production with emphasis on functional design requirements; instrumentation methods and results.

590. Special Topics. Cr. 1 to 5.

Agricultural Mechanization

Clarence W. Bockhop, Professor in Charge

Undergraduate Study

For undergraduate curriculum in agricultural mechanization leading to the degree Bachelor of Science, see College of Agriculture, Curriculum.

The Department of Agricultural Engineering provides a curriculum for those students interested in agricultural mechanization. The agricultural mechanization courses in farm structures and animal environment, soil and water conservation, farm power and machinery, electric power and processing, construction and maintenance, and agricultural safety give the student knowledge of the application of agricultural engineering technology to agriculture.

The curriculum prepares students for careers with agricultural service organizations; farm machinery industries, electric power suppliers; governmental service agencies; manufacturers of farm buildings; contractors; feed, fertilizer, and chemical companies; or in farming. The agricultural mechanization graduates apply agricultural, biological, physical.
mechanical, business, and safety knowledge to serve agriculture in the areas of production, promotion, management, sales and service, and testing, as well as in dealer and consumer education.

Graduate Study

The Department of Agricultural Engineering offers courses for minor graduate credit in agricultural mechanization for students in agriculture.

Courses open to graduate students for minor credit only: 406, 411, 412, 415, 417, 418, 420, 421, 434, 439, 474, 490.

Courses Primarily for Undergraduate Students

110. Orientation in Agricultural Mechanization. (1-0) Cr. R. F. The opportunities and challenges of agricultural mechanization and its relation to the agricultural industry.

134. Farm Machinery Management. * (1-3) Cr. 2. F. W. For students in winter quarter and two-year farm operation programs only. Calibration, selection, management, and cost of using machinery.

136. Power Sources for Agriculture. (2-3) Cr. 3. S. For students in two-year farm operation program only. Production uses of gasoline engines in agricultural enterprises. Principles and operation of the internal combustion engine. Horsepower conversion, cost of operation, and efficiency as related to agricultural equipment.

154. Agricultural Maintenance Welding. ** (2-4) 5 weeks. Cr. 2. W. For students in quarter farm operation program only. Selection of welding machines and materials and their application in agriculture.

164. Electrical Equipment for Farms. (9-4) Cr. 2. W. For students in winter quarter and two-year farm operation programs only. Selection, application, and maintenance of electrical equipment used in the electrification and mechanization of farmsteads.


216. Agricultural Structures. (3-0) Cr. 3. F. W. S.S.S. 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.S.S. Selection of building materials and their application to agricultural construction.

306. Soil and Water Management. (2-3) Cr. 3. F.S.S.S. Prerequisite: Sophomore classification. Engineering aspects of soil and water conservation for students in agriculture. Use of the level, land description, design, location, and construction of erosion control and drainage facilities. Field trips to problem areas.


344. Small Power Equipment. (2-3) Cr. 3. F.S. Prerequisite: Junior classification. Operation, adjustment, and maintenance of small internal combustion engines and associated equipment.

345. Tractor Power. (2-3) Cr. 3. F.W. Prerequisite: Junior classification. Selection, operation, adjustment, capacity, and care of tractors and internal combustion engines.

354. Advanced Metal Construction and Maintenance. (2-4) Cr. 3. F.W.S.S.S. Prerequisite: 254. Advanced techniques in metal construction and repair of agricultural equipment including oxyacetylene and arc welding.


364. Farm Electricity. (2-3) Cr. 3. F.W.S.S.S. Use of electricity in productive farm enterprises and in the improvement of farm living. Electrical safety and protection. Motors, controls, and wiring for work simplification.


371. Water Use in Outdoor Recreation. (3-0) Cr. 3. W. Prerequisite: Junior classification. Recognition and definition of problem areas in outdoor recreation. Water sources, quantity and quality considerations, waste disposal, irrigation and drainage, mapping.

401. Seminar. (1-0) Cr. R. Yr. Preparation, presentation, and discussion of topics on agricultural mechanization.


418. Teaching Agricultural Mechanics I. (2-2) Cr. 3. F.W. Prerequisite: 254, 255. Objectives and methods; equipment and shop equipment; adjustment of the shop; organization of shop programs. Students will plan and present demonstrations of methods of teaching mechanical skills.

417. Teaching Agricultural Mechanics II. (8-0) Cr. 3. S. Off-campus. Prerequisite: 418. Organization of instructional units; selection of tools, equipment, supplies, and reference materials; development and organization of facilities for instruction in high school and vocational-technical programs.

419. Developments in Agricultural Mechanics. (1-2 or 2-4) Cr. 1 or 2. F.W.S.S. Off-campus. Five weeks. Prerequisite: 415. Selection, principles of operation, application and maintenance of equipment and materials used in mechanized agriculture and development of instructional units for vocation-technical programs.

A. Small Gasoline Engines
B. Electric Motors
C. Controls for Automation in Agriculture
D. Electricity in Agriculture
E. Materials for Agricultural Structures
F. Tractor Engines
G. Hydraulics in Agriculture
H. Metal Construction
I. Agricultural Machinery

Analysis of pressure, flow, and directional control valves. Analysis and design of hydraulic systems for power and control functions.

461. Electrical Energy Application in Agriculture. (2-6) Cr. 4. F. Prerequisite: Credit or classification in E E 445. Characteristics of motors, controls, and phase converters and their applications to agricultural machines. Instrumentation and techniques applied to agricultural production.


471. Principles of Livestock Waste Management. (3-3) Cr. 4. S. Prerequisite: 231. Principles of chemistry, bacteriology, and engineering applied to the collection, treatment, and disposal of animal wastes.


490. Special Problems. Cr. 1 to 5.

H. Honors.
P. Power and Machinery.
Q. Structures and Environment.
R. Electric Power and Processing.
S. Soil and Water.
T. Construction and Maintenance.

Courses for Graduate Students, major or minor


661, 662, 663. Seminar. (1-0) Cr. 1 each Yr. Discussion of research problems, methods, procedures, and reports.


699. Research.
N. Crop Conditioning and Storage.
P. Power and Machinery.
Q. Structures and Environment.
R. Electric Power and Processing.
S. Soil and Water.

Agricultural Mechanization

Clarence W. Bockhop, Professor in Charge

Undergraduate Study

For undergraduate curriculum in agricultural mechanization leading to the degree Bachelor of Science, see College of Agriculture, Curricula.

The Department of Agricultural Engineering provides a curriculum for those students interested in agricultural mechanization. The agricultural mechanization courses in farm structures and animal environment, soil and water conservation, farm power and machinery, electric power and processing, construction and maintenance, and agricultural safety give the student knowledge of the application of agricultural engineering technology to agriculture.

The curriculum prepares students for careers with agricultural service organizations; farm machinery industries, electric power suppliers; governmental service agencies; manufacturers of farm buildings; contractors; feed, fertilizer, and chemical companies; or in farming. The agricultural mechanization graduates apply agricultural, biological, physical,
mechanical, business, and safety knowledge to serve agriculture in the areas of production, promotion, management, sales and service, and testing, as well as in dealer and consumer education.

Graduate Study

The Department of Agricultural Engineering offers courses for minor graduate credit in agricultural mechanization for students in agriculture.

Courses open to graduate students for minor credit only: 406, 411, 412, 415, 417, 418, 420, 421, 434, 439, 474, 490.

Courses Primarily for Undergraduate Students

110. Orientation in Agricultural Mechanization. (1-0) Cr. R. F. The opportunities and challenges of agricultural mechanization and its relation to the agricultural industry.

134. Farm Machinery Management. * (1-3) Cr. 2. F. (2-4) 5 weeks. Cr. 2. W. For students in winter quarter and two-year farm operation programs only. Calibration, selection, management, and cost of using machinery.

136. Power Sources for Agriculture. (2-3) Cr. 3. S. For students in two-year farm operation program only. Production uses of gasoline engines in agricultural enterprises. Principles and operation of the internal combustion engine. Horsepower conversion, cost of operation, and efficiency as related to agricultural equipment.

154. Agricultural Maintenance Welding. ** (2-4) 5 weeks. Cr. 2. W. For students in winter quarter farm operation program only. Selection of welding machines and materials and their application in agriculture.

164. Electrical Equipment for Farms. (6-4) Cr. 2. W. For students in winter quarter and two-year farm operation programs only. Selection, application, and maintenance of electrical equipment used in the electrification and mechanization of farms and areas.


219. Livestock Buildings and Equipment. (3-0) Cr. 3. W. For students in winter quarter and two-year farm operation programs only. Environmental influences on performance and behavior of livestock and poultry. Planning buildings and equipment for animal production.

254. Metal Construction and Maintenance. ** (2-4) Cr. 3. F.W.S.SS. Selection and application of ferrous and nonferrous metals. Welding, cold-working, and hot-working metal in agricultural construction and maintenance.

255. Agricultural Construction Materials and Procedures. (2-4) Cr. 3. F.W.S.SS. Selection of building materials and their application to agricultural construction.

306. Soil and Water Management. (2-3) Cr. 3. F.S.SS. Prerequisite: Sophomore classification. Engineering aspects of soil and water conservation for students in agriculture. Use of the level, land description, design, location, and construction of erosion control and drainage facilities. Field trips to problem areas.


344. Small Power Equipment. (2-3) Cr. 3. F.S. Prerequisite: Junior classification. Operation, adjustment, and maintenance of small internal combustion engines and associated equipment.

345. Tractor Power. (2-3) Cr. 3. F.W. Prerequisite: Junior classification. 334. Construction, operation, adjustment, capacity, and care of tractors and internal combustion engines.

354. Advanced Metal Construction and Maintenance. (2-4) Cr. 3. F.W.S.SS. Prerequisite: 254. Advanced techniques in metal construction and repair of agricultural equipment for students in agriculture.


364. Farm Electricity. (2-3) Cr. 3. F.W.S.SS. Use of electricity in productive farm enterprises and in the improvement of farm living. Electrical safety and protection. Motors, controls, and wiring for work simplification.


371. Water Use in Outdoor Recreation. (3-0) Cr. 3. W. Prerequisite: Junior classification. Recognition and definition of problem areas in outdoor recreation. Water sources, quantity and quality considerations, wastes disposal, irrigation and drainage, mapping.

401. Seminar. (1-4) Cr. R. Yr. Preparation, presentation, and discussion of topics on agricultural mechanization.


415. Teaching Agricultural Mechanics I. (2-2) Cr. 3. F.W. Prerequisite: 254, 255. Objectives and methods; equipment and management of the shop; organization of shop program. Students will plan and present demonstrations of methods of teaching mechanical skills.

417. Teaching Agricultural Mechanics II. (3-0) Cr. 3. S. Off-campus. Prerequisite: 254. Organization of instructional laboratories; selection of tools, equipment, supplies, and reference materials; development and organization of facilities for instruction in high school and vocational-technical programs.

418. Developments in Agricultural Mechanics. (1-2 or 2-1) Cr. 1 or 2. F.W.S.SS. Off-campus. Five weeks. Prerequisite: 415. Selection, principles of operation, application and maintenance of equipment and materials used in mechanized agriculture and development of instructional units for vocational-technical programs.

A. Small Gasoline Engines
B. Electric Motors
C. Controls for Automation in Agriculture
D. Electricity in Agriculture
E. Materials for Agricultural Structures
F. Tractor Engines
G. Hydraulics in Agriculture
H. Metal Construction
I. Agricultural Machinery

420. Water Supply and Animal Waste Management. (3-0) Cr. 3. Alt. W., offered 1974. Prerequisite: Junior classification, ten credits in biological science. Planning farmstead water systems, home waste disposal, and livestock waste management. The control of pollution and the developing of mechanized systems for waste handling.


490. Special Problems. Cr. 1 to 5.

H. Honors.
Q. Power and Machinery.
R. Structures and Environment.
S. Soil and Water.
T. Construction and Maintenance.

* The department recommends that credit in both 134 and 334 not be applied toward graduation.
** The department recommends that credit in both 164 and 254 not be applied toward graduation.

Agriculture

Lee R. Kolmer, Dean of Agriculture
Louis M. Thompson, Associate Dean

Professor: Wallace
Assistant Professors: Alexander, Brune
Instructors: Hobberg, Mohn, Pals, Plambeck, Stadiman, Weber

Courses listed below are offered for undergraduate students in all curricula of the College of Agriculture. See also individual curricula in the section College of Agriculture.

104. Practical Work. A minimum of six months' practical work in the student's field of study is required for graduation. This requirement should be met before the beginning of the junior year.

110. Farm Operation Orientation. (1-0) Cr. R. F.W.

290. Special Problems. Cr. 1 to 3. Prerequisite: Sophomore classification. Independent study for two-year farm operation students in a specific area for which no course is available and in an area not assigned to an existing department. Approved by the professor in charge of the farm operation curriculum.

450. Farm Operation. (3-4) Cr. 4. F.W.S.S. Prerequisite: Econ 330, junior classification in College of Agriculture. Participation in the management and operation of an Iowa farm. The class is responsible for the plans, records, and decisions of buying and selling of livestock, crops, and equipment. Trips to farms and markets.

490. Special Problems. Cr. 1 to 3. Prerequisite: Junior classification in the College of Agriculture. Independent study of a specific area for which no course is available and in an area not assigned to an existing department. The proposals by the student is subject to the approval of the associate dean or the head of the farm operation curriculum.


Agronomy

John T. Pesek, Jr., Head of Department


Associate Professors: Irving Carlson, Clark, Dumenil, Eldredge, Fehr, Fenton, George, Hodges, Jarvis, Loesch, Pearce, Taylor, Troch, Webb, Yarger.


Instructors: Jennings, Pepper, Prior.

Undergraduate Study

For undergraduate curriculum in agronomy, see College of Agriculture, Curricula.

Students selecting agronomy as a major will prepare themselves for positions in agricultural industry, business and government. Graduates accept positions in the seed, fertilizer, and chemical industries as agronomists, production managers, and sales and promotion personnel. State and federal agencies employ agronomists as extension specialists, county extension directors, soil scientists, soil conservationists, and food and drug inspectors. Land appraisal, farm
management, turfgrass management, and farming are additional areas of work open to agronomists. Students who are reasonably certain of going on to graduate school should elect the agronomic science specialty.

Graduate Study

The department offers work for the degrees Master of Science and Doctor of Philosophy with majors in crop production and physiology, plant breeding, soil physics, soil chemistry, soil fertility, soil microbiology and biochemistry, soil morphology and genesis, soil management, and agricultural climatology. Minor work is provided for students taking major work in other departments. A nonthesis option is available for the master's degree.

The department also cooperates in the interdepartmental program of water resources. (See Water Resources.)

Prerequisite to major graduate work in crop science and soil science is completion of an undergraduate curriculum substantially equivalent to that recommended for pregraduate training in the agronomy curriculum at this institution. The foreign-language requirement, if any, for the M.S. and Ph.D. degrees is established on an individual basis by the program-of-study committee appointed to guide the work of the student.


Courses Primarily for Undergraduate Students


112. Crop Production. (3-0) Cr. 3. W. Green. For students in winter quarter farm operation program only. Application of plant-soil-climate relationships to crop production practices. The department recommends that credit in both 112 and 114 not be applied toward graduation.

114. Principles of Crop Production. (2-3 to 8 individualized study) Cr. 4. F.W.S. Introductory principles of plant-soil-climate relationships in crop production. The department recommends that credit in both 112 and 114 not be applied toward graduation.

152. Soils. (3-0) Cr. 3. For students in winter quarter farm operation program only. Stritzel. Principles and concepts regarding soil formation and classification. Relationships between the physical-chemical properties of soil and their management. The department recommends that credit in both 152 and 154 not be applied toward graduation.

154. Fundamentals of Soil Science. (2-3 to 6 arr.) Cr. 4. F.W.S.SSI. Prerequisite: Chem 141 or 147. Schafer. Introduction to physical, chemical, and biological properties of soils, their formation, classification, and distribution. Rural and urban use. The department recommends that credit in both 154 and 152 not be applied toward graduation.


212. Grain and Forage Crops. (3-2) Cr. 4. F.W.S. Prerequisite: 114. George. Crop-plant characteristics, adaptation, and quality with major emphasis on the production and management of forages, corn, soybeans, and small grain crops common to midwest agriculture.

244. Soil Fertility and Crop Management. Cr. 3. S. Prerequisite: 112 or 114 and 152 or 154. Stritzel. Integrating soil fertility and crop management principles and practices into profitable land-use programs. Characteristics and use of fertilizers and agricultural chemicals in crop production.

310. Agronomy Seminar. (1-0) Cr. 1. F.W. Prerequisite: 206; 354, Stat 101 or 104. Thompson. Interpretation of research with emphasis relating to soil-plant and soil-plant-climate relationships.


315. Crop Growth and Culture. (4-0) Cr. 4. F.W.S. Prerequisite: 114, Biol 101; Chem 251 recommended. Pearson. Physiological aspects of crop growth; application to cultural practices.

318. Principles of Crop Physiology. (3-0) Cr. 3. S. Prerequisite: Bot 310 or 320. Pearson. Basic principles concerning the growth, development and production of crop communities in relation to their environment.

326. Seed Technology. (Bot 326) See Botany. Everson.


357. Forest Soils. (For 357) (4-3) Cr. 5. W. Prerequisite: Chem 231. Scholtes. Formation, classification, and occurrence of soils. Physical, chemical, and biological soil factors affecting forest growth.


400. Agricultural Travel Course. Cr. 4. SSI. Prerequisite: Junior or senior classification, permission of instructor. A. American Tour, offered 1975. B. European Tour, offered 1974. Students taking this course will also be required to register for Am.S. 400 for 4 credits. Tour and study of production methods in major crop and livestock regions of the United States and other countries. Influence of climate, soil, topography, markets, and other factors on livestock and crop production.

408. Climates of the Continent. (Meteor 408) (3-2) Cr. 3. W. Prerequisite: 206, Math 101, senior classification. Shaw. World climatology and factors controlling it. Climatic analogues as a means of comparing climates. The climates of different continents.

409. Crop Protection. (3-0) Cr. 3. W. Prerequisite: Junior classification and 5 credits in biology. Stanforth. Practices related to the biological, chemical, and cultural control of weeds, insects, and plant diseases, with particular emphasis on the use and principles underlying the herbicide, insecticide, and fungicide technologies.

411. Crop Science Seminar. (1-0) Cr. 1. W.S. Prerequisite: Senior classification. Interpretation and presentation of research data relating to crop science.

413. Turfgrass Science. (Hort 413) See Horticulture.


Courses Primarily for Graduate Students, major or minor, open to qualified undergraduates

500. Orientation Seminar. (1-0) Cr. 1. F. Prerequisite: Graduate classification in agronomy, and from foreign country. Pesek and staff. An introduction to Iowa and U.S. agriculture for international scholars. Field trips when possible. Emphasis on role in the functioning of research, teaching, and extension in fulfilling the charge given the land-grant university.

505. Microclimatology. (Mteor 505) (3-0) Cr. 3. S. Prerequisite: 206. Shaw. The heat exchange near the ground. Relation of topography and plant cover to the microclimate. Modification of micro-climate by agricultural operations.


518. Advanced Crop Production. (3-0) Cr. 3. W. Prerequisite: 315 or 318 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. Pasture and Forage Research Methods. (3-0) Cr. 3. Alt. W., offered 1975. Prerequisite: Stat 401 and Agron 434, or permission of instructor. Wedin. Research methods for pasture and forage intake-quality assessment in studies either dependent on or independent of animal effects. Application and evaluation of methods to grassland development. Analysis and interpretations of pasture and forage research results, with considerations of forage economics.

553. Soil-Plant Relationships. (3-0) Cr. 3. F. Prerequisite: 354. Black. Composition and properties of soils in relation to the nutrition and growth of plants.


577. Soil Physics. (3-0) Cr. 3. F. Prerequisite: 354, Math. 22 recommended. 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.

590. Special Topics. Cr. arr. Prerequisite: Fifteen credits in agronomy. Literature reviews and conferences on selected topics in crops, soils, or climatology according to needs and interest of student. For foreign students, an analysis of soil, climatic, and crop production resources of the student’s home country is suggested.

Courses for Graduate Students, major or minor

600. Seminar. (1-0) Cr. 1. F.W.S.S. Reports and discussions of recent literature and current investigations.

A. Crops. Carlson, Fehr, Hallauer.
B. Soils. Black.
C. Soil-Plant-Climate. Shaw.

609. Agricultural Climatology. (0-1) Cr. 1. F.W.S.S. Shaw. Consultation with instructor, special problems, and/or reports on reading assigned in consultations with the instructor.

615. Environmental Crop Physiology. (3-0) Cr. 3. S. Prerequisite: Fundamental background in plant physiology and crop science. Shibles. The plant-environment interaction in relation to growth and production of crop communities.

620. Colloquium in Crop Physiology. (0-2) Cr. 1. W. Prerequisite: Graduate classification and permission of instructor. Anderson, Pearson, Shibles, Wedin, Woolley. Presentation of papers and informal discussion of selected literature topics in crop physiology.

623. Cytogenetics in Plant Breeding. (3-0) Cr. 3. S. Prerequisite: 524, Gen 401, Bot 605. Peterson. Cytogenetics 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. (4-0) Cr. 4. W. Prerequisite: 524, Stat 436, Gen 630. Russell. Genes and action in plant breeding. Topics include inheritance, inbreeding depression and heterosis, development of genetic stocks, and population structure to inducing variability and to selection procedures; theory of pure lines, synthetics, and multiline varieties; importance of genetic shifts and homeostasis in plant breeding.

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, synthetics, and multiline varieties; importance of genetic shifts and homeostasis in plant breeding.


699. Research.

A. Agricultural Climatology.
B. Crop Production and Physiology.
C. Plant Breeding and Cytogenetics.
D. Soil Chemistry.
E. Soil Fertility.
F. Soil Management.
G. Soil Microbiology and Biochemistry (Bact 699)
H. Soil Morphology and Genetics.
I. Soil Physics.

Air Force Aerospace Studies

Professor and Head of Department: Col. Loye.
Associate Professor: Maj. Shiffert.
Assistant Professors: Capt. Larkins, Capt. Lansdale, Capt. Marlier

Undergraduate Study

The objective of Air Force Aerospace Studies is to provide officers commissioned as second lieutenants who are interested in careers in the Air Force.

The curriculum is divided into two two-year phases, the general military course (GMC) and the professional officer course (POC). Students may elect to substitute a 6-week field training period at an Air Force base for the GMC portion of the curriculum. Completion of the general military course either on campus or in the 6-week field training is a prerequisite for entry into the professional officer course. Cadets who complete the on-campus GMC classes are required to attend a 4-week field training period if they elect to enroll in the POC.

Selection for the professional officer course is on a competitive basis, and cadets enrolling in this course must meet certain mental, physical, and moral standards. Qualified cadets may elect classification as flight candidates and receive flight instruction during their final year in the POC. Upon enrollment in the POC, all cadets are required to complete a contractual agreement with the Air Force, which obligates them to four years of active duty as an officer in the United States Air Force if in a nonflying category, and six years if a pilot or navigator. Uniforms and texts are supplied to the cadets, and those in the POC receive a monthly subsistence allowance. The best qualified cadets participate in a College Scholarship Program (CSP)
that provides payment of full tuition, fees, and textbooks. In addition, the CSP cadet receives the same subsistence allowance paid all cadets who have entered into the contractual agreement. Eligibility requirements for the CSP change from time to time; interested students should contact the Department.

Additional information concerning Air Force Officer Education may be obtained from the Professor of Aerospace Studies, Iowa State University. Also see Officer Education, this catalog.

Courses Primarily for Undergraduate Students

141, 142, 143. Contemporary United States Military Forces. (1-0) Cr. 1 each. Yr. Functions of U.S. military forces; defense organization and policy making; policies and strategies of Soviet Union and Communist China, and U.S. defense alliances.

141A, 142A, 143A, 144A, 145A, 146A, 146B. Air Force Corps Training. (0-1) Cr. R. Yr. Initial military training related to wearing the uniform, engaging in military customs and courtesies, participating in military ceremonies, giving military commands and instructions, correcting and evaluating such skills, and learning the responsibility of an Air Force officer. Most of time spent with formal and informal presentations describing work of an officer.


244, 245, 246. Growth and Development of Aerospace Power. (3-0) Cr. 3 each. Yr. Prerequisite: 243 or equivalent. Aerospace power, aeronautics, and space operations; probable developments in manned aircraft and space operations. Development of communication skills needed by junior officers.

341A, 342A, 343A, 344A, 345A, 346A, 347A. Corps Training. (0-1) Cr. R. Yr. Advanced leadership training pertaining to planning, organizing, supervising, conducting, inspecting, and evaluating military activities; preparing and presenting briefings and other communications; providing counsel, guidance, information, and other services which increase the understanding, motivation, and performance of other cadets.

401. Primary Ground School. (3-0) Cr. 3. F. Prerequisite: 343 or equivalent. Theory of first Federal Aviation Regulations; aviation meteorology; aerial navigation; flight computers; radio communications.

441, 442, 443. The Professional Officer. (3-0) Cr. 3 each. Yr. Prerequisite: 343. Professionalism, leadership, and management; meaning of professionalism and professional responsibilities; the military justice system, leadership theory and practices, management principles and functions, problem solving; management tools, practices, and controls.

Animal Science

L.H. Hazel, Head of Department

Professor: Anderson, Balloun, Bercford (Emeritus), Burroughs, de Baca, Eggleton, Ewing, Foreman, Freeman, Goll, Haynes, Herrick, Jacobson, Kildee, Kline, LaGrange, Lee, Lush, Marion, Melampy, McGilliard, Nordskog, Porter, Self, Shearer, Sims, Speer, Trenkle, Vølker, Willham, Zmolek.

Associate Professors: Bracken, Christian, EASTWOOD, Ewan, Kiser, Owings, Parrish, Robson, Rust, Stevermer, Stromer, Topel, Vetter, Warner, Wickersham, Young, Zimmerman.


Instructors: Olson.

Undergraduate Study

For undergraduate curricula in animal science and dairy science, see College of Agriculture, Curricula.

The department offers the degrees Bachelor of Science in animal science, Bachelor of Science in dairy science, and complementary work toward admission to schools of law, medicine, and veterinary medicine in either curricula.

Graduate Study

The department offers work for the degrees Bachelor of Science and Doctor of Philosophy with majors in animal breeding, animal nutrition, meat science, muscle biology, nutritional physiology, physiology of reproduction, poultry breeding, poultry nutrition, and poultry products technology. Minor work is offered in these areas to students taking major work in other departments. For students desiring more general training, the degree Master of Science is offered in animal production. In this program additional course work may be substituted for a thesis.

A strong undergraduate program is required for those students interested in graduate study. Fundamental training in biology, chemistry, mathematics, and statistics is requisite to a satisfactory graduate program. Graduate programs in animal science include supporting work in areas such as agronomy, anatomy, bacteriology, biochemistry, chemistry, economics, food technology, genetics, physiology, and statistics. Students may choose graduate programs involving a joint major with one of these areas.

The department also cooperates in the interdepartmental program of cell biology. (See Cell Biology.)

The foreign language requirement, if any, is established on an individual basis by the program-of-study committee appointed to guide the work of the student.

Open to graduate students for minor credit only: 318, 319, 350, 351, 420, 423, 425, 427, 429, 431, 434, 436, 437, 470, 471.

Courses Primarily for Undergraduate Students

114. Animal Production. (4-2) Cr. 5. F.W.S. Basic elements of the comparative characteristics and bodily functions of farm animals, their place in animal agriculture, and the production, evaluation, and marketing of their products. Includes cattle for meat and milk, horses, sheep, swine and poultry.

115. Light Horses and Ponies. (2-2) Cr. 3. F.W.S. Breeds of horses and ponies for work and pleasure. Selecting, judging, breeding, feeding, care, management, and marketing.

170. Meat and Meat Processing. (2-2) Cr. 3. F.W.S. Prerequisite: 114 or F.N. 107. Composition of meat and its nutritive value. Selection, grading, identifying, curing, and processing meats.

218. Feeds and Feeding. (3-2) Cr. 4. F.W.S. Prerequisite: 114. Practical feeding and management of hogs, beef and dairy cattle, and sheep. Not accepted for credit for animal and dairy science degrees. The department recommends that credit in both 218 and 319 not be applied toward graduation.

225. Animals in the American Economy. (3-2) Cr. 4. F.W.S. The origins, development, and contribution of distinct animal types. Adapting animals to the changing needs of society.


301. Poultry Science Techniques. (1-3) Cr. 2. F. Prerequisite: 114. Brant. A laboratory course designed to supplement 114. Selection of breeding and laying stock, grading of eggs, premortem and postmortem grading of poultry, study of internal organs and their functions. Trips to nearby poultry farms.


319. Applied Animal Nutrition. (4-0) Cr. 4. F.W.S. Prerequisite: 318. Zimmerman. Essential nutritive requirements of livestock and poultry, sources and composition of nutrients, replacement value of feeds in rations, identification of ingredients, ration formulation, and feeding recommendations. The department recommends that credit in both 218 and 319 not be applied toward graduation.


335. Dairy Cattle Selection. (0-6) Cr. 2. S. Prerequisite: Sophomore standing. Wunder. Selection of breeding animals for dairy herds. Comparative terminology, decision-making, and presentation of oral reasons. Trips to dairy cattle farms.


400. Agricultural Travel Course. Cr. 4. S. Prerequisite: Junior or senior classification. Limited enrollment. A. American Tour, offered 1975. B. European Tour, offered 1974. Students taking this course will also be required to register for Agron 400 for 4 credits. Tour and study of production methods in major livestock and crop regions of the United States and other countries. Influence of climate, soil, topography, markets, and other factors on livestock and crops produced.


423. Poultry Production. (3-0) Cr. 3. S. Brant. Prerequisite: 318. Practical feeding and management of chicken and turkey flocks. Operational study of commercial farms, including production and marketing practices.

425. Pork Production. (3-0) Cr. 3. F.W.S. Prerequisite: 319, 350; 351 recommended. Christian. Life-cycle swine production.

427. Beef Production. (4-0) Cr. 4. F.W.S. Prerequisite: 319. 350; 351 recommended. Brackenberg. The beef industry from conception to consumption. Cow-calf and feedlot operations.

429. Sheep Production. (3-0) Cr. 3. F.W.S. Prerequisite: 318, 350; 351 recommended. Warner. Calendarized farm flock program. Programs for feeder lambs. Wool.

431. Animal Reproduction L (4-0) Cr. 4. F.W.S. Prerequisite: V Phys 264 or equivalent. Melampy. Comparative anatomy, physiology, and endocrinology of animal reproduction.


480. Animal Nutrition. (5-0) Cr. 5. S. Prerequisite: Fourth-year classification in veterinary medicine curriculum. Nutrient requirements for animals. Sources and composition of nutrients; ration formulation and feeding practices.
Courses Primarily for Graduate Students, major or minor, open to qualified undergraduates

503. Seminar in Animal Production. (1-0) Cr. 1. F.S. Prerequisite: Permission of instructor. Discussion and evaluation of current topics in animal production and management.

508. Animal Experimentation. (3-2) Cr. 4. W. Prerequisite: Stat 401. Christian. The scientific method in animal research. Recognizing and defining important problems in the livestock industry. Emphasis upon planning and conducting animal experiments and interpretation of the observed results.


519. Advanced Ruminant Nutrition I. (3-0) Cr. 3. S. Prerequisite: 319. Burroughs. Digestion, absorption, and metabolism of nutrients related to maintenance growth, lactation, and reproduction in ruminants.


560. Special Topics. Cr. 1 to 3. Select topics in the animal sciences, offered on demand and often conducted by guest professors.

618. Advanced Nutrition—Minerals and Vitamins. (4-0) Cr. 4. F. Prerequisite: B & B 406. Ewan. The role of vitamins and minerals in mammalian intermediary metabolism. Integration of cellular biochemistry and physiology of vitamins and minerals.


620. Advanced Nutrition—Energy. (3-0) Cr. 3. S. Prerequisite: B & B 406. Young. Energy constituents of feedstuffs and energy needs of animals as related to cellular biochemistry and physiology. Interpretations of classical and current research.


Courses for Graduate Students, major or minor

603. Seminar in Animal Nutrition. (1-0) Cr. 1. F.W.S. Prerequisite: Permission of instructor. Discussion of current literature; preparation and submission of abstracts.


Anthropology

For description of courses, see Sociology and Anthropology.
Applied Art

Clair B. Watson, Head of Department

Professors: Adams, Meixner, Navin, Petersen.
Associate Professors: Danielson, Dawn, Fenimore, Hamlin, Heggen, Held
Assistant Professors: Allen, Dake, Elizabeth Miller, Morgan, Picken, Polster, Rogers, Stratton
Instructors: Bro, Figura, Hedrick, Hromyak, Kumbier, McIlrath, Melby, Arthur Miller, Tow, Townsend, Warme

Undergraduate Study

For undergraduate curriculum in applied art leading to the degree Bachelor of Arts see Home Economics, Curricula.

The department offers work for the degree Bachelor of Arts with majors in advertising design, art education, craft design, and interior design.

I. Advertising design. This major prepares students for positions in graphic design, for work requiring imagination and skills in the layout and design of communication media that will express concept and purpose with clarity and style.

II. Art education. This major is planned for students preparing for certification to teach art in grades kindergarten through twelve. Students may enroll in art education. However, to be admitted to the teacher education program, the student must be accepted by a department committee and the committee on Academic Standards of the College of Education. The program outlined for art education is under the College of Home Economics, Department of Applied Art. For general requirements for teacher certification, see College of Education.

III. Craft design. This major provides a broad background in crafts with a strong emphasis in two craft media. The student is prepared to operate a shop or market crafts, to engage in freelance design, to work in an organizational capacity in community or welfare workshops, or to become a teacher in public or private adult education.

IV. Interior design. This major is planned for art students who enter the professional field of interior design.

Students applying for advanced credit must submit representative work.

Graduate Study

The department offers work for the degree Master of Arts with major in Applied Art and minor work to students taking major work in other departments. Within the Applied Art major the student may specialize in advertising design, art education, craft design, and interior design.

Full acceptance into the graduate program requires satisfactory evidence of ability in the specified area and the completion of a curriculum substantially equivalent to that required of undergraduate students in Applied Art at this institution. Of the forty-five credits required in the graduate program, a minimum of nine credits must be taken outside of the department. The candidate's graduate committee will decide if additional work is necessary.

The graduate program in this department requires an original work or group of works or an investigation. Either of these must be accompanied by an appropriate thesis. Candidates may be required to prepare an exhibition of their work during their last term in residence.

There is no foreign language requirement for the degree Master of Arts.

The department also cooperates in the interdepartmental program of housing (see Housing).

Open to graduate students for minor only: 433, 446, 467, 468, 474, 484.

Courses Primarily for Undergraduate Students

103. 104. Design. 103: (2-6) Cr. 4; 104: (0-6) Cr. 3. F.W.S.SSI. Prerequisite: 104; 103. 103: Creative problems in design and color with emphasis on art elements and principles. 104: Two- and three-dimensional forms in design; varied materials and techniques.

160. Drawing. (0-6) Cr. 3. F.W.S.SSI. Introduction to drawing and composition in black and white media to develop figurative and nonfigurative expression. Fee.

170. Lettering. (0-8) Cr. 3. F.W.S. Classic, traditional, and modern letter forms.

200. Art for the Elementary School. (1-8) Cr. 3. F.W.S.SSI. Experimentation with materials and processes in two and three dimensions suitable for the teaching of arts and crafts in the elementary school. Fee.

203. Color. (1-4) Cr. 3. F.W.S. Prerequisite: 103. Color theory and problems to develop awareness of color interaction, sensation, and light.

233. Water-Based Media. (0-6) Cr. 3. F.W.S.SSI Prerequisite: 103. Methods of painting and their relationship to interpretation, color, and composition. Fee.

243. Structural Fabric Design. (0-9) Cr. 3. F.W.S.SSI. Prerequisite: 103. Fabric construction through nonloom processes; visual awareness of color through use of natural fiber and dyes. Fee.

244. 245. Weaving. (0-9) Cr. 3 each; 244: F.W.S.SSI; 245: W.S. Prerequisite: 244: 108; 245: 203, 244, 244. 245: Fabric design on a four-harness loom. 245: Advanced weaving with emphasis on design of two- and three-dimensional fabrics for useful or decorative purposes.

247. Design in Metal and Enamel. (0-9) Cr. 3. F.W.S.SSI. Prerequisite: 108, E Gr 121. Design and manipulation of copper, brass, and pewter and the application of basic enameling processes. Fee.

250. Intermediate Drawing. (0-6) Cr. 3. F.W.S.SSI Prerequisite: 150. Advanced study in drawing techniques and experimental media with emphasis on drawing as an art form. Fee.

261, 262. Fundamentals of Interior Design. 261: (2-4) Cr. 4. F.W.S.SSI: 262: (0-6) Cr. 3. S. Prerequisite: 261: 103; 262: 261. For nonmajors only. 261: Principles of design and color applied to the exterior, interior, and furnishings of the house. 262: Problems in design and color in the interior; analysis of home furnishings and house design.

264. Interior Sketching. (0-6) Cr. 3. F.W. Prerequisite: 233. Varied techniques in rendering interiors.

270. Lettering for Graphics. (0-9) Cr. 3. F.W. Prerequisite: 103, 170. Advanced problems in letter design, application, and technique.
272. Typography. (0-9) Cr. 3. W.S. Prerequisite: 270. Type and its application in graphic layout.

276, 179. Fashion Illustration. 276: (0-9) Cr. 3. F.W.S.; 276: (0-9) Cr. 3. S. Prerequisite: 276: 150; 276: 278. Illustration of the fashion figure, costume rendering, layout.

301, 302, 303. History of Art. (3-0) Cr. 3 each. 301: F.W.; 302: W.S.; 303: F.S. Prerequisite: 302: 301; 303: 302. Styles of architecture, painting, and sculpture from prehistoric times to the present, emphasizing artists and their works in the cultures that produced them.

333. Painting. (0-9) Cr. 3. F.W.S. Prerequisite: 233, 250. Introduction to oil painting and new media. Fee.


345. Design in Wood. (0-9) Cr. 3. F.W.S.SSI. Prerequisite: 104, B Cr. 121. Design and construction in wood with orientation to basic woodworking equipment.


360. Life Drawing. (0-9) Cr. 3. F.W.S. Prerequisite: 250. Artistic anatomy, drawing from the model, and portrait in various media.


372. Graphic Art Production. (0-9) Cr. 3. W.S. Prerequisite: 370. Printed production methods and processes. Experiences involving professional studio practices required for each process.

384. Survey of Art. (3-0) Cr. 3. F.W.S.SSI. Prerequisite: Junior standing. Survey of the art of all ages, emphasizing art as an expression of cultures.


417, 418. Supervised Teaching of Art. Cr. 8 each. F.S. Prerequisite: All courses in the art education curriculum. Advanced reservation required. 417: Supervised teaching in the secondary school. 418: Supervised teaching in the elementary school.

433. Advanced Painting. (0-9) Cr. 3. W.S. Prerequisite: 333. Emphasis on experimentation in painting.

446. Jewelry. (0-9) Cr. 3. F.W.S.SSI. Prerequisite: 247. Basic soldering, construction, forging, and vacuum-casting methods as they apply to specific designs in sterling silver jewelry. Fee.

466. Apprenticeship. Cr. 9. SSI following the junior year. Prerequisite: 301, 347, 361, 365. Practical interior design shop experience.

467. Commercial Interior Design. (0-6) Cr. 3. F.S. Prerequisite: 366. Advanced decorative planning; commercial and contract problems.

468. Professional Interior Design Procedures. (3-0) Cr. 3. F. Prerequisite: Credit or classification in 467. Written specifications; cost of materials and general procedures for interior designers.


484. History of Ornament. (3-0) Cr. 3. S. A study of historic ornament with emphasis on the arts of the past and their application to the present.


Courses Primarily for Graduate Students, major or minor, open to qualified undergraduates

500. Short Course. Cr. arr. SSI. Prerequisite: Permission of instructor.

Courses for Graduate Students, major or minor

590. Special Topics. Cr. arr. F.W.S.SSI. Prerequisite: Bachelor's degree in applied art or evidence of satisfactory equivalency in the specified area.

A. Painting and Composition.
B. Applied Textile Design.
C. Weaving.
D. Ceramics. Fee.
E. Interior Design.
F. Advertising Design.
G. Fashion Illustration.
J. Jewelry. Fee.
K. Design in Wood.
L. Design in Metal and Enamel. Fee.
M. Art Education.

605. Seminar. Cr. arr. F.W.S.

699. Research.

Architecture

Martin D. Gehner, Head of Department

Professors: Kocimski, McKeown, Patten, Reed, Stone.
Associate Professors: Heemstra, Kitzman, Rogness, Shank, Simmons, Slater, Toporek.
Assistant Professors: Clemens, DeKovic, Dunker, Ekroth, Lorr, Maves, Mukerjea, Rice, Rudi, Shao, Wilson, Young.
Undergraduate Study

For curriculum in architecture leading to the degrees of Bachelor of Arts and Master of Architecture, see College of Engineering, Curricula.

The architect seeks to shape an environment that encourages the growth of human values. The undergraduate curriculum provides the academic introduction to the professional degree program. The specific courses develop the technical vocabulary to permit expression as an architect. The program of electives encourages individuals to study in depth or in breadth according to their particular interests and aptitudes. An optional foreign studies program is offered. The degree Bachelor of Arts is awarded upon successful completion of the four-year program.

Graduate Study

The department offers work for the degree Master of Architecture with major in architecture and minor work to students taking major work in other departments.

The master's program is designed to educate professional architects to work effectively within contemporary constraints, to comprehend continuing changes within our society, and to formulate concepts for a better human environment. Individual study under the guidance of a graduate committee is required. Professional experience following undergraduate studies is recommended prior to admission to the graduate program.

Students who are qualified to enter graduate college and who possess the degree Bachelor of Arts in architecture should receive the degree Master of Architecture upon successful completion of a program of studies consisting of at least: Arch 501 (2 cr.), 514A (4 cr.); 30 credits of supporting course work, 54 credits of seminar, Research and/or Design. Students who are qualified to enter graduate college and who possess the professional degree Bachelor of Architecture should receive the degree Master of Architecture upon successful completion of a program of studies consisting of at least: Arch 501 (2 cr.), 514B (4 cr.); 15 credits of supporting course work; and 24 credits of seminar, Research and/or Design. A minimum of 45 graduate credits must be earned at Iowa State University.

There is no foreign language requirement for the degree Master of Architecture. Graduate students with the consent of their committee may participate in the departmental foreign studies program.

The department also participates in the interdepartmental program in housing (see Housing).

Open to graduate students for minor credit only: Arch 421, 422, 423, 430, 444, 446, 447, 463.

Courses Primarily for Undergraduate Students

101. Orientation (3-0) Cr. 3. F.W.S. Introduction to architecture, emphasizing the relationships between man and his physical environment. Class discussions include ecology, cities and their institutions, dwelling environments. The architect and his profession. Visiting lecturers, films, field trips.

211, 212, 311, 312, 411, 412. Design (0-15) Cr. 5 each.


The minimum required undergraduate sequence: Projects in architectural design of elementary and intermediate scale, studies in construction. Problem solving and communication processes. Integration of systems. Recognition and synthesis of objective and subjective values. Studio, seminar, field trips.

300. Systems of Visual Order. (0-9) Cr. 3. F.W.S. Perceptual and physical responses to the environment. Formal elements of two and three dimensional design, point, line, plane, etc. Spatial relations, visual organization and materials, ordering systems. Vocabulary of design. Relationship of elements and ordering systems to architectural design. This course may be taken at any time as long as it is taken before or concurrently with 312.


332. Two-dimensional Studio. (0-6) Cr. 2 each time taken. F.W.S. Visual aesthetics explored through the forces and inherent stimulants of forms, space, light, motion relationships. Ordering systems with various materials utilizing techniques of manipulation, addition, subtraction, substitution. Individual and group projects. No more than 8 credits will be allowed for the sum of credits taken in 332 and 532.

333. Three-dimensional Studio. (0-6) Cr. 2 each time taken. F.W.S. Perceptual investigation of conceptions and manipulation of form, space, light, motion relationships. Ordering systems with various materials utilizing techniques of manipulation, addition, subtraction, substitution. Individual and group projects. No more than 8 credits will be allowed for the sum of credits taken in 333 and 533.


361. Residential Architecture I. (3-0) Cr. 3. F.W. Principles of planning and design of houses with consideration given to site selection, financing, planning, equipment, materials, and methods of construction.

382. Residential Architecture II. (3-0) Cr. 3. F.W. Prerequisite: 381. Principles of planning and design of individual units housing with consideration given to the social, economic, and political factors.

421, 422, 423. History of Architecture II. (0-6) Cr. 3 each. Yr. Prerequisites: 421: 323; 422: 323; 423: 421. The development of architecture, considering relationships to the site, to the surroundings, to the culture, and to the visual arts. Field trips: Survey of the modern movement from the early eighteenth century into the twentieth century. 422: Early North American architecture. The architecture of the colonies and the development of the Federal style. 423: The architectural philosophies and architectural criticism of the nineteenth and twentieth centuries.
Courses for Graduate Students, major or minor

616. Research and/or Design. (0-9 to 0-99) Cr. 1 to 12 each time taken. F.W.S.S. Prerequisite: Approval of major professor. Individual research and/or design projects.

Bacteriology

William R. Lockhart, Chairman of Department

Professors: Durand, Frederick, Hartman, Pattee, Quinn, Reinbold, Walker

Associate Professors: Holt, Williams

For undergraduate curriculum in sciences and humanities, major in bacteriology, leading to the degree Bachelor of Science, see Sciences and Humanities, Curriculum.

In this department, principal emphasis is placed on understanding the interrelationships of bacteria in nature, the application of bacteriology in agriculture and industry, and the study of fundamental life processes using bacteria as primitive examples of living things. Varied careers are open to qualified graduates: in hospital and clinical laboratories, in federal, state, or local government organizations, and in research and development and quality-control laboratories maintained by the dairy and food processing, pharmaceutical, and fermentation industries, among others. Some fields of bacteriology, especially advanced research, may require further training. Undergraduate work in the department is designed to provide sound preparation for graduate study.

Undergraduate programs usually include the following basic courses: 300, 320, 330, 340, and 490. The following courses are desirable as supporting work: Chem 211, 334, 335, 336; Phys 111, 112, 113; Math 120 or 130; Stat 101; Biol 101, 101A, 103, 106, 107; Gen 350. These lists of courses

Courses Primarily for Graduate Students, major or minor, open to qualified undergraduates

501. Seminar. (2-0) Cr. 2. F.W.S. Prerequisite: 412. Investigation and organization of changing conceptual relationships within and between the profession of architecture and society.

502. Seminar. (1-0 to 3-0) Cr. 1 to 3 each time taken. F.W.S. Prerequisite: 412. Synthesis, professional orientation, seminar discussion and lectures. Field trips, visiting critics, selected projects.

514A, 514B. Design. (0-12) Cr. 4 each. F.W.S. Prerequisites: 514A: 412. 514B: professional degree. Complex urban architectural design problems.

532. Advanced Two-dimensional Studio. (0-6) Cr. 2 each time taken. F.W.S. Prerequisites: 332 and 6 credits in freehand drawing. Advanced studies investigating visual effects of color, form, media, technique, and style relating to symbolic, decorative, and expressive statements for independent and architecturally related projects through the idiom of studio painting and two-dimensional constructs, utilizing industrial products, acrylic, and oil paints. No more than 8 credits will be allowed for the sum of credits taken in 332 and 532.

583. Advanced Three-dimensional Studio. (0-8) Cr. 2 each time taken. F.W.S. Prerequisites: 333 and 6 credits in freehand drawing. Emphasis on development of effective procedures appropriate to student selected studies in various contemporary sculptural media. Form, meaning, and purpose of plastic statements independent, intermediate, and integral with architecture. No more than 8 credits will be allowed for the sum of credits in 333 and 533.

543. Office Practice. (3-0) Cr. 3. S. Prerequisites: 343, 110 and 356A. Contract documents, office procedure and administration.

581, 582, 583. Theory of Urban Design. (2-0) Cr. 2 each. F.W.S. Prerequisites: 581: 421; 582: 591; 583: 582. History, theory, and problems relating to the determinants of urban design.

580. Special Topics. Cr. 1 to 5 each time taken. Prerequisite: Written approval of instructor and department head. Individual research and design projects.

Courses and Programs

430. Freehand Drawing II. (0-6) Cr. 2 each time elected. F.W.S. Prerequisite: Six credits in freehand drawing.

A. Charcoal.
B. Pencil.
C. Color.
D. Pen and Ink.

432. Advanced Architectural Graphics I. (0-9) Cr. 3. F.W.S. Prerequisites: E Gr. 243 and 4 credits in freehand drawing. Applied principles of graphic renderings; such as, tonality interactions, scale interpretation, environmental illusionary symbols (trees, people, objects), spatial illusion, applied perspective relationships, and perceptual implications of natural visual phenomena to graphic illusion techniques. Through simple limited graphic media.

432. Advanced Architectural Graphics II. (0-9) Cr. 3. W.S. Prerequisites: 431. Exploration of a variety of visual graphic rendering media in applications of the principles of Arch 431 and explorations of combinations of visual presentation media.

433. Architectural Graphic Communication. (0-9) Cr. 3. S.F. Prerequisite: 432. Graphic communications of total architectural concepts, including both physical and non-physical considerations of design solutions; such as, functional derivations of problems solutions, spatial order systems, environmental criteria, and social-psychological implications. Through multiple visual graphic media and presentation techniques.

444, 446, 447. Architectural Technologies II. (2-3) Cr. 3 each. 444: F.W.; 446: W.S.; 447: F.W.S. Prerequisites: 444, 446, 447: 453 and Phys. 112. 447 must be taken concurrently with 412. 444: The luminous environment and electrical systems. 446: The thermal environment and mechanical systems, including water supply and sanitation. 447: The acoustical environment and noise control. The integration of the concepts of mechanical, electrical, and acoustical systems with architectural design courses, and with architectural concepts.

463. Housing. (3-0) Cr. 3. F.S. Prerequisite: 302. Principles of planning and design of group or multiple housing with consideration given to the social, economic, and political factors. Field trip.

490. Special Problems in Architecture. Cr. 2 to 9. Prerequisite: Written approval of instructor and department head. Investigation of problems of special interest to the student. H. Honors.
are neither fixed requirements nor complete outlines of the work necessary for the major, but are intended as a guide for students and advisers in planning individual programs.

Graduate Study

The department offers work for the degrees Master of Science and Doctor of Philosophy with major in bacteriology, and minor work to students majoring in other departments. Within the major the student may specialize in immunology; in virology; in food, applied, medical, or systematic bacteriology; or in microbial ecology, genetics, physiology, or morphology. Major graduate study in veterinary bacteriology, soil bacteriology, and dairy bacteriology is offered in the departments of Veterinary Microbiology, Agronomy, and Food Technology, respectively.

Specific prerequisite to major work in bacteriology is the completion of thorough courses in general bacteriology, biology, organic chemistry, and physics. Biochemistry, physical chemistry, and mathematics are advised. Minor study usually is selected from chemistry, biochemistry and biophysics, botany, zoology, genetics, mathematics, and statistics.

The department also participates in the interdepartmental program in cell biology. See Cell Biology.

Candidates for the Ph.D. degree must demonstrate their ability to translate scientific articles from one modern foreign language. Language examinations are administered by the department.

Open to graduate students for minor only: 408, 412, 413, 414, 450, 485.

Courses Primarily for Graduate Students


490. Special Problems. (Biol 490) Cr. 1 to 5. Prerequisite: 340 and permission of instructor. Honors Program.

Courses Primarily for Graduate Students, major or minor, open to qualified undergraduates

525. Applied Microbiology. (3-0) Cr. 3. F. Prerequisite: 300. Utilization of microorganisms in agriculture and industry.

575. Immunology. (Imblo 575) (3-6) Cr. 5. S. Prerequisite: 300. Theories of immunity and immunization; preparation of vaccines and antisera; antigen-antibody reactions.


Courses for Graduate Students, major or minor

601, 602, 603. Advanced Bacteriology. (3-6) Cr. 5 each Yr. Prerequisite: 601. Permission of instructor; 602: 601; 603: 602. 601: Bacterial nutrition; metabolic and genetic control of cell function; influence of physical and chemical environment on bacteria. 602: Metabolism, biosynthetic and catabolic pathways; methods for study of metabolic pathways. 603: Morphology and cytology of the major groups of bacteria; principles governing the classification of bacteria.

610. Special Topics. Cr. 2 to 5. Prerequisite: Permission of instructor. Selected topics of current interest.

615. Molecular Virology. (3-6) Cr. 5. S. Prerequisite: 408 or 603. Structure, function, and genetics of viruses and virus-like agents; host-virus interactions.

620. Molecular Genetics. (Gen 620) See Genetics.

621. Bacterial Genetics. (Gen 621) (3-6) Cr. 5. F. Prerequisite: 603. Isolation, characterization, and use of mutant bacteria; mechanisms of genetic exchange and their application to genetic and biochemical analysis of bacteria.


655. Advanced Food Microbiology. (F Tch 655) See Food Technology.


678. Tissue Cell Culture Responses to Pathogens. (3-6) Cr. 5. Alt. F., offered 1973. Prerequisite: 603. Methods for tissue cell culture propagation; measurement of tissue cell metabolism; comparison of pathogen-free and infected cultures.


699. Research.
Biochemistry and Biophysics

Jack Horowitz, Chairman of Department

Professors: Applequist, Dahm, French, Fromm, Goll, Graves, Metzler, Snyder, Byron H. Thomas, Wildman

Associate Professors: Atherly, Foss, Gaessler, Hearn, Insande, Outka, Rebers, Robson, Rougvie, Tipton, Young

Instructors: Warner

Undergraduate Study

For the undergraduate curriculum in sciences and humanities with 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 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 provide sound preparation for graduate work leading to the doctorate.

Undergraduate biochemists usually have the following basic courses or their equivalents in their programs: B & B 101, 102, 103, 201, 401, (or 501, 502, 503), 461, 511; Chem 114, 115, 120, 224, 325, 326, 327, 330, 331, 332, 333; Math 120, 121, 122, 213, 223; Biol 101, 101A; Zoology 106 and 455, or C Bio 428, or Bot 107, 310; Bact 300; Gen 350.

Biochemists usually include the following basic courses in their programs: B & B 101, 102, 103, 461; Chem 114, 115, 120, 321, 322, 323, 331, 332, 333; Math 120, 121, 122, 213, 223, 321, 322, 409, 410; Phys 221, 222, 223, 311, (or Chem 322L, 323L), 447, 448, 449; Biol 101, 101A; Zoology 106 and 455, or C Bio 428, or Bot 107, 310; Gen 350.

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.

Every major is required to earn 12 credits in French, German, or Russian.

Graduate Study

The department offers work for the degrees Master of Science and Doctor of Philosophy with majors in biochemistry and in biophysics and minor work to students taking major work in other departments. The department also participates in the interdepartmental programs in cell biology. (See Cell Biology.)

Prerequisite to graduate work is completion of sufficient undergraduate work in chemistry, mathematics, physics, and biology.

There is no foreign language requirement for the degree Master of Science. Candidates for the degree Doctor of Philosophy must demonstrate a reading knowledge of one foreign language, chosen from French, German, or Russian, by passing (50th percentile or better) the Educational Testing Service examination. A foreign student whose native language is Chinese, French, German, Italian, Japanese, Russian, or Spanish may be excused from the foreign language examination.

Open to graduate students for minor credit only: 304, 305, 401, 404, 405, 406, 461.

Courses Primarily for Undergraduate Students

101. Introduction to Biochemistry. (2-0) Cr. 2. F. Fundamentals of biochemistry including structures of biopolymers, fundamentals of biocatalysis and metabolism. Open only to majors in biochemistry and biophysics.

102, 103. Introduction to Biochemical Activities. (1-0) Cr. 1 each. 102: W.; 103: S. Prerequisite: 101. Research activities and career opportunities in biochemistry.

201. The Chemistry of Life. (3-0) Cr. 3. S. Prerequisite: Two quarters of inorganic chemistry, and permission of instructor. Chemical basis of selected aspects of enzymology, metabolism, and genetics. For sophomores majors in biochemistry and biophysics; open to others desiring a sophisticated introduction to biochemistry.

301. Survey of Biochemistry. (3-0) Cr. 3. F.W.S.S. Prerequisite: A course in organic chemistry. Includes chemistry of biological molecules, and selected aspects of metabolism. Not accepted for credit toward a chemistry, biochemistry, or biophysics major. For students in agriculture, biology, teacher education, and home economics.

304, 305. Physiological Chemistry. (3-0) Cr. 3 each. 304: F; 305: W. Prerequisite: Chem 336, 340: Structure and function of proteins; enzymology; biological oxidation; chemistry and metabolism of carbohydrates. 305: Chemistry and metabolism of lipids, amino acids, nucleic acids, protein synthesis, and the genetic code. Not accepted for credit toward a chemistry, biochemistry, or biophysics major.

311. Laboratory in Biochemistry. (0-6) Cr. 2. F.W.S. Prerequisite: Credit or classification in 301. Emphasis on characterization, isolation and function of biological substances by use of modern techniques. Not accepted for credit toward a chemistry, biochemistry, or biophysics major.

314, 315. Laboratory in Physiological Chemistry. 314: (0-6) Cr. 1 W.; 315: (1-2) Cr. 2. S. Prerequisite: 314: Freshmen can stand for University College of Veterinary Medicine; 315: 314. To accompany B & B 304, 305 and V Phys 314, 315. Not accepted for credit toward a chemistry, biochemistry, or biophysics major.

401. Principles of Biochemistry. (4-0) Cr. 4. S. Prerequisite: Credit or classification in Chem 333 or 335; Phys 113 or 223. Introduction to biochemistry with empha-
sis on understanding biochemical mechanisms. Topics include metabolism, biopolymers, enzymes, molecular biology, and regulatory mechanisms. For students in physical and biological sciences, and in engineering.

*404, 405, 406. Biochemistry. (3-0) Cr. 3 each. Yr. Prerequisite: Chem 335; Chem 336 recommended. A general biochemistry course intended primarily for students in biology, agriculture, and home economics, with emphasis on intermediary metabolism and the biochemistry of higher organisms. 404, 405: Catalysis, bioenergetics, chemical biology of physical materials, intermediary metabolism and synthesis of biopolymers. 406: Structure, function, and synthesis of DNA and RNA; protein biosynthesis; metabolic regulation in procaryotic and eucaryotic organisms.

461. Introduction to Biophysics. (3-0) Cr. 3. F. Prerequisite: Chem 115 or 142, Phys 113 or 223. Ideas and methods used in biophysics to attack fundamental biological problems. A study of several currently active research areas such as molecular genetics, contractility, nerve conduction and vision.

490. Special Problems. Cr. arr.
H. Honors Program.

499. Undergraduate Research. Cr. 2 to 5 each time taken. Prerequisite: Permission of staff member with whom student proposes to work, B average in all previous courses. Literature survey and research under senior staff guidance.

Courses Primarily for Graduate Students, major or minor

501, 502, 503. General Biochemistry. (4-0) Cr. 4 each. Yr. Prerequisite: Courses in analytical chemistry, organic chemistry (Chem 333 or 335) and physical chemistry (Chem 332 or 335). Concurrent enrollment in physical chemistry may be permitted with consent of instructor. Chemical composition of living matter and the chemistry of life processes. For graduate students in biochemistry and biophysics, and advanced undergraduates in chemistry and for other qualified students desiring a rigorous course.

511, 512. Laboratory in General Biochemistry. (1-6) Cr. 3 each. 511: F.; 512: W. Prerequisite: 511: 401, or 405, or credit or classification in 501; 512: 511. Modern techniques of biochemical research.

521. Radiobiology. (1-6) Cr. 3. W. Prerequisite: Chem 420, permission of instructor. Heinz, White. A laboratory course in biochemical uses of radiotropes. Basic counting techniques, dilution techniques, determination of position of label, elucidation of reaction mechanisms.


561, 562. Biophysical Methods. (3-0) Cr. 3 each. 561: W.; 562: S. Prerequisite: Fundamental training in biology, physics, and calculus. Organic and physical chemistry, permission of instructor. Foss, Rowgie. Optical techniques: spectroscopy and spectrophotometry, birefringence, optical rotation, light scattering, etc. Methods for the study of macromolecules; viscosity, diffusion, ultra centrifugation, electrophoresis, X-ray diffraction.

571, 572. Laboratory in Biophysics. (0-6) Cr. 2 each. 571: W.; 572: S. Prerequisite: Permission of instructor. Foss, Rowgie. To accompany 561, 562.


576. Laboratory in Microscopy. (0-6) Cr. 2. S. Prerequisite: Credit or classification in 574. Oltzka. Practical experience in microscopy. Designed to be taken concurrently with 574.

581, 582. Seminar. (1-0) Cr. 1 each. 581: F.; 582: W. Prerequisite: Permission of instructor. Short talks and discussion by students on assigned topics. For entering graduate students and qualified seniors.

590. Special Topics. Cr. arr.

Courses for Graduate Students, major or minor

*601. Advanced Biochemistry. Cr. 1 to 3 each time taken. F.W.S. Prerequisite: 501, and permission of instructor.
A. Lipids.
B. Protein Chemistry.
C. Mechanism of Enzyme Action.
D. Nucleic Acid Structure and Function.
E. Biochemical Regulation.
F. Coenzymes and Bio-organic Mechanisms.
G. Physical Biochemistry.
H. Developmental Biochemistry.
I. Recent Developments.

*622. Carbohydrate Chemistry. (3-0) Cr. 3. S. Prerequisite: Permission of instructor. Chemical behavior and enzymic relationships of sugars and polysaccharides.

661. Advanced Biophysics. (3-0) Cr. 3 each time taken. F. Prerequisite: Permission of instructor. Study of topics in biophysical research such as molecular genetics, muscle contraction and motility, nerve conduction, vision, hearing, photosynthesis, and structure of biological systems. Radiation biology, new or advanced techniques, and macromolecular physics and chemistry.


681. Advanced Seminar. (1-0) Cr. R. F.W.S.
A. Student Presentations.
B. Staff and Visitor Presentations.


689. Research. Prerequisite: Permission of staff member concerned.

*Administered by the College of Agriculture. Courses not marked by an asterisk are administered by the College of Sciences and Humanities.

+The department recommends that only one of the following courses be used for graduation credit: 501, 504, 401.

Biology


Undergraduate and graduate courses and research opportunities in basic biology at Iowa State University are provided by the departments of Bacteriology, Biochemistry and Biophysics, Botany and Plant Pathology, Genetics, and Zoology and
Entomology. The biology courses listed below are taught under a cooperative arrangement among these departments. In addition, the departments of Agronomy, Animal Science, Child Development, Food and Nutrition, Food Technology, Forestry, Horticulture, Psychology; departments within the College of Veterinary Medicine; and major programs in biomedical engineering, and fisheries and wildlife biology provide undergraduate and graduate instruction as well as research programs in applied and specialized phases of the biological sciences.

**Undergraduate Study**

Biol. 101, 102A, 102B, and 103 provide a broad look at the origin, structure and function of living organisms as well as their interactions, particularly with respect to man. They are recommended to those students planning minimal work in the sciences. Most students intending to take more advanced work in any of the biological sciences would benefit from the following 23-credit sequence: Biol. 101, 101A, 103, 106, 107, and 300. This sequence serves as a core around which a student majoring in biology, or in one of the biological sciences, will build his professional program.

For the undergraduate curriculum in sciences and humanities, major in biology, leading to the degree of Bachelor of Science, see Sciences and Humanities, Curriculum. The interdepartmental undergraduate major in biology offers broad training in the understanding of biological concepts and methods of investigation. The training provided in this program is particularly well suited for those planning to teach biology as a career. However, opportunities exist in industry, health-related institutions, and government for men and women well trained in biology. While some employment opportunities do exist in governmental, hospital, and industrial laboratories for persons with a baccalaureate in biology, students who meet the necessary high standards are encouraged to continue their studies in a graduate college.

Undergraduates majoring in biology are advised by a faculty member from one of the participating departments. In addition to the 23 credits of core biology, their programs include the following basic courses: B & B 301, or 401, or 404 and 405 and 406; Biol 309; Bot 306, 320, 404; Gen 350; and Zool 320 and/or 334, 455.

At least one additional course or sequence of courses in the biological sciences is elected from the following list: Bact 320, 330, 340; Biol 303, 438; Bot 256, 304; C Bio 428; Zool 200, 304, 307, 311, 370; or a field biology sequence at Iowa Lakeside Laboratory (Bot 301L and Zool 302L).

Supporting courses include physics, two quarters of general chemistry, one or two quarters of organic chemistry (preferably Chem 334, 335), and at least three quarters of applied or theoretical mathematics. Credits for at least one year of a foreign language are required.

Biology majors seeking certification to teach secondary school biology must formally apply for admission to the Teacher Education Program. See Index, Teacher Certification.

Proposed changes in the above requirements to fit individual student needs can be considered, subject to approval by the biology committee.

**Graduate Study**

A nonthesis Master of Science degree in general graduate studies (biology) is offered for teachers who wish to broaden and supplement their training in biology and related areas. (See General Graduate Studies.) This program is intended to strengthen the biological background of candidates without requiring the specialized thesis research of the traditional master's degree. Forty-five graduate credits, earned during the academic year or during the summer, are required for the degree. A student's program, which is cooperatively designed to fit the student's professional needs, consists of courses in three major subject matter areas. A written report based on field, laboratory, or library research is expected.

In addition to the nonthesis degree in general graduate studies (biology), graduate research leading to the master's degree or the Doctor of Philosophy is offered in each of the departments of biological science. Interdepartmental graduate programs in cell biology, immunobiology, and water resources also are available. See Cell Biology, Immunobiology, and Water Resources.

**Courses Primarily for Undergraduate Students**

101. Principles of Biology. (3-0) Cr. 3. F.W.S.SSI. Scope of biology as a science; organization and operation of living systems with emphasis upon cells, metabolism, growth, development, reproduction, inheritance, and basis for evolution. Laboratory courses recommended to complement Biol 101 are 101A for students intending to major in the biological sciences, and either 102A or 102B, or both, for nonmajors.

101A. Experimental Biology. (1-3) Cr. 2. F.W.S.SSI. Prerequisite: Credit or classification in 101. Modern methods and instrumentation in the laboratory study of fundamental biological principles. Primarily for majors in the biological sciences and related areas, but open to any students interested in this type of laboratory experience.

102A. Biology of Plants, Bacteria, and Viruses. (1-3) Cr. 2. F.W.S.SSI. Prerequisite: Credit or classification in 101. Function, structure, development, and evolution of plants, bacteria, viruses, and human disease. Primarily for students who do not plan to take 107.

102B. Biology of Animals. (1-3) Cr. 2. F.W.S.SSI. Prerequisite: Credit or classification in 101. Examination of structure, function, development, behavior, and evolution of representative animals. Primarily for students who do not plan to take 106.

103. Environmental Biology. (3-0) Cr. 3. F.W.S.SSI. Man's changing environment. Principles of ecology; population dynamics; biogeochemical cycles; misuse of resources; environmental pollution.


107. General Botany. (Bot 107) See Botany.
300. Introductory Bacteriology. (Bact 300) See Bacteriology.

303. Biological Evolution. (Bot 303, Zool 303) (4-9) Cr. 4. W.S. Prerequisite: Credit or classification in 101A; or 101 and 102A or 102B. Origin, unity and diversity of organisms; sources and interpretation of evidence; natural selection; analysis of genetic mechanisms of evolution including recombination, rates and types of mutations, and population variations.

309. Basic Ecology. (Bot 309, Zool 309) (3-3) Cr. 4. P. Prerequisite: 103 and 108 or 107. Basic concepts of ecology dealing with plants, animals, and their physical environment from an ecosystem point of view. Field trips will include intensive studies as well as general surveys of local habitats and environmental problems.

408. General Virology. (Bact 408) See Bacteriology.


490. Special Problems. (Bact 490) See Bacteriology.


490. Botany. (Bot 490) See Botany.

490. Genetics. (Gen 490) See Genetics.


Biomedical Engineering

Neal R. Cholvin, Chairman

Professors: Magilton, McCormack, Pearson, Potter, Seagrave, Young

Associate Professors: Brockman, Carlson, Engen, Gillette, Van Gelder

Graduate Study

The biomedical engineering program is interdisciplinary in scope and is sponsored jointly by the colleges of Engineering and Veterinary Medicine. Graduates with training in biomedical engineering are concerned with the application of engineering concepts and analytical techniques to biological and medical problems. They are interested in developing new concepts and instrumentation for measurements of living systems. In addition, they seek to understand those unique phenomena of living systems which have functional capabilities desirable for incorporation in the design of physical systems. Following completion of biomedical engineering training, they engage in research careers in the various fields of biology and engineering, and in the environmental sciences. They may work on multidisciplinary teams in industrial, government, or academic research institutes. Individuals with this training can correlate and adapt engineering principles to the problem of medicine and biology. They are knowledgeable in, and can contribute to, such fields as physiology, anatomy, pharmacodynamics, and diagnostics by developing new quantitative methods of scientific investigation.

Undergraduate Study

A curriculum leading to a bachelor's degree in biomedical engineering is not offered. Undergraduate students planning graduate study are encouraged to develop knowledge in subjects prerequisite to biomedical engineering courses. For example, undergraduate students majoring in engineering, physics, or mathematics are encouraged to elect courses in organic chemistry, biochemistry, and biology. Undergraduate students majoring in life science areas should prepare for graduate study by electing courses in mathematics, engineering, and physics.

Graduate Study

Work is offered for the degrees Master of Science and Doctor of Philosophy with major in biomedical engineering, and minor work for students taking major work in other areas. Prerequisite to major and minor work in the interdepartmental program of biomedical engineering is an undergraduate degree in one of the fields of engineering, life sciences, physical sciences, or a professional degree in one of the fields of medicine. Depending upon the individual's background, the major student will usually elect minor work in at least one of the following curricula: veterinary anatomy, biochemistry and biophysics, chemical engineering, computer science, electrical engineering, engineering mechanics, mathematics, mechanical engineering, veterinary anatomy, veterinary clinical sciences, veterinary physiology, psychology, or zoology. All students are encouraged to obtain previous background knowledge of organic chemistry, calculus, beginning differential equations, and physics. There is no foreign language requirement for either the Master of Science degree or the Doctor of Philosophy degree.

The program of formal courses taken by students will be oriented toward developing proficiency in research in the interdisciplinary field. Selected background as well as advanced course work from other related disciplines will be taken in conjunction with appropriate biomedical engineering course topics. The program of formal courses will vary, depending upon the background and interests of the student, and will be determined in consultation with the student's committee.

In addition to the courses described later, the following courses are recognized to have strong bearing on studies in biomedical engineering:

An S 506
B & B 461, 561, 562, 574, 575, 661
C Bio 428, 527, 528
Courses and Programs

Courses Primarily for Undergraduate Students

401. Scope of Biomedical Engineering. (1-0) Cr. 1. W. Prerequisite: Permission of program chairman. Topics characteristic of research in biomedical engineering. For undergraduate students who wish to become familiar with the field of biomedical engineering.

471. Basic Biomedical Electronics. (3-0) Cr. 3. S. Prerequisite: Phys 112. Practical introductory electronics including AC circuit theory, rectification, amplification, oscillators, and power supplies. Biological and medical instruments including pressure and flow transducers, signal processors, recorders, measurement of bioelectric potentials, and artifact suppression. (This course is designed for students majoring in the life sciences and is not acceptable for major or minor credit in biomedical engineering.)

Courses Primarily for Graduate Students, major or minor

521. Electrical Circuits for Biomedical Engineering. (2-0) Cr. 2. W. Prerequisite: E E 441, credit or classification in E E 445. Introduction to concepts of frequency response, bridge circuits, and transformers.


534. Biomedical Applications of Heat and Mass Transfer. (3-0) Cr. 3. S. Prerequisite: 561, E M 420. The principles of heat and mass transfer applied to biomedical problems. Applications in the study of physiology and in the design and operation of artificial organs.

561, 562, 563. Comparative Mammalian Anatomy and Physiology. (V An 561, 562, 563) (V Phys 561, 562, 563) 561: (3-3) Cr. 4. F; 562: (4-3) Cr. S. W.; 563: (3-3) Cr. 4. S. Prerequisite: 561: Credit or classification in B & B 304; 562: 561, credit or classification in B & B 305; 563: 562. Integrated teaching approach for graduate students who have had little or no previous training in anatomy and physiology. Designed for students in animal nutrition, biochemistry, engineering, food and nutrition, psychology, and other biological sciences. 561: Cellular structure and function, nervous system, sense organs, muscles, skeletal systems. 562: Cardiovascular system, respiration, acid-base balance, excretion. 563: Digestion, metabolism, reproduction, and endocrine systems.

571. Theory and Techniques of Biological Instrumentation. (3-0) Cr. 3. W. Prerequisite: 563, Math 321. Characteristics of biological signals, transducers, error and artifact suppression, biological data acquisition and processing systems.

572. Simulation of Biological Systems. (3-3) Cr. 4. S. Prerequisite: 522, 569, Math 321. Theory and operation of analog computers. Development of mathematical models for biological control systems and application of analog computers to the simulation of these systems.

590. Special Topics. Cr. 1 to 5 as arranged. Prerequisite: Permission of instructor. Investigation of problems of special interest in biomedical engineering.

592. Advanced Biomedical System Simulation. (3-0) Cr. 3. F. Prerequisite: 572. Selected simulation topics of current interest in biomedical engineering.

600. Seminar. (1-0) Cr. 1. As arr.

661. Biomedical Data Processing. (3-0) Cr. 3. S. Prerequisite: 522. Digital data acquisition systems used in biomedical research, hardware, data reduction algorithms, digital filters.

665. Information Processing in Living Systems. (3-0) Cr. 3. S. Prerequisite: 522. Nervous and neuron network models, information processing in living systems, artificial intelligence and pattern recognition.

699. Research.

Botany and Plant Pathology

Frederick G. Smith, Head of Department


Associate Professors: Burris, Clark, Epstein, Foley, Franke, Hill, Horner, LaMotte, Martinson, Nevin, Stewart, Wildman, Wooten.

Assistant Professors: Farrar, Hill, Lewin, Nyvall.

Undergraduate Study

For undergraduate curriculum in sciences and humanities, major in botany, leading to the degree Bachelor of Science, see Sciences and Humanities, Curriculum.

For undergraduate major in plant pathology leading to the degree Bachelor of Science, see Agriculture, Curriculum.

The department offers broad study opportunity 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 science-related occupations, including biology teaching, conservation and outdoor recreation activities, and traineeships in research, development, and sales programs of industry and agriculture. Both
majors offer excellent preparation for graduate study in botany, or plant pathology, or in related disciplines such as agronomy, biology, horticulture, forestry, plant breeding, and water resources.

The Iowa State University Seed Laboratory offers formal course work in seed science and technology and provides practical experience through part-time employment.

Undergraduate programs in the department usually include the following biological science courses: Biol 101, 101A, 103, 106, 300; Bot 107, 203, 306, 320, 404, 407, 424, 505. These are supplemented with others from the following: Bot 216, 301, 304, 338, 399, 438, 500, 506, 564, 594. Undergraduate minor programs and supporting courses usually include: B & B 301; Chem 141, 141L, 142, 142L, 211, 334, 335; Gen 305; Geol 100; Zool 320, 370, 455. Supporting work in mathematical sciences and physics is strongly advised. 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 students and their advisers in planning a program best fitted to individual needs.

Graduate Study

The department offers work for the degrees Master of Science and Doctor of Philosophy with majors in botany or plant pathology, and minor work for students majoring in other departments. Within the botany major one of the following areas of specialization may be designated: aquatic plant biology, cytology, ecology, economic botany, morphology, mycology, physiology, or taxonomy. A Master of Science nonthesis option is available.

The department also participates in the interdepartmental programs of cell biology and water resources. See Cell Biology and Water Resources.

Students entering graduate programs in the department should have a basic background in the physical, biological, and mathematical sciences as well as adequate preparation in English and one foreign language where appropriate.

There is no foreign language requirement for the degree Master of Science. For the degree Doctor of Philosophy in botany, the minimum requirement is one foreign language. For the degree Doctor of Philosophy in plant pathology, the requirement is established by the student's advisory committee.

Open to students for graduate minor credit: 320, 404, 407, 408, 416, 417, 424, 428, 438.

Courses Primarily for Undergraduate Students

107. General Botany. (Biol. 107) (3-6) Cr. 5. W.S.SSI. Prerequisite: Biol 101A. Dodd. The relationship of structure and function, development, reproduction, and evolutionary relationships of representative plants.

110. Technical Lecture. (1-0) Cr. R; S. Required of students in the plant pathology curriculum. Requirements and opportunities for work in the field of plant pathology.

155. Local Flora. (0-6) Cr. 3. S.SSI. Tiffany. Field and laboratory studies in common local plants, including trees, shrubs, and spring flowering plants. Field trips. Not recommended for students with professional interests in plant science.

203. Field Botany. (0-6) Cr. 3. F. Prerequisite: 107. Pohl. Field and laboratory study of plants in various local habitats. Introduction to use of keys and basic ecological concepts. Field trips.


256. dendrology. (For 256) (2-6) Cr. 4. F. Prerequisite: 107. Families, genera, and species of North American trees; angiosperms and gymnosperms. Field trips.

301L. Field Biology. (See list of courses offered at the Iowa Lakeside Laboratory.)

303. Biological Evolution. (Biol 303) See Biology.


307. Fundamentals of Botany. (3-3) Cr. 4. S. Prerequisite: Chem 142, Chem 142L. Knaphus. Study of plant structure and functions with emphasis on physiology of flowering plants.


310. Plant Physiology. (3-3) Cr. 4. F.W.SSI. Prerequisite: Biol 102A or Bot 107; Chem 142 and Chem 142L. Stewart. Basic physiological processes important to man and the biosphere. Role of plants in acquisition and conservation of matter and energy. Growth and development, and their control by internal and external factors.

320. Plant Physiology. (3-6) Cr. 5. S. Prerequisite: 107; Chem 334 or B & B 301. Nevins. Application of elementary physical and biological principles to the understanding of plant processes involved in assimilation, metabolism, and regulation of growth and development. Experimental approach emphasized. The department recommends that credit in both 310 and 320 be applied toward graduation.


399. Undergraduate Seminar. (1-0) Cr. 1 each time taken. W. Prerequisite: Junior classification and 12 credits in botany. Knaphus. Meetings of students and staff to discuss topics of current interest in plant science.

404. Plant Anatomy. (2-6) Cr. 4. F.W.SSI. or IL. Prerequisite: 107. Lerensten. Structure and development of vegetative and reproductive organs of vascular plants, with emphasis on angiosperms. Includes introduction to basic microtechniques.

407. Principles of Plant Pathology. (2-4) Cr. 4. F.S. Prerequisite: 310 or 320. Principles underlying the nature and control of plant diseases.

408. General Virology. (Bact 408) See Bacteriology.


416. Forest Pathology. (For 416) (2-6) Cr. 4. S. Prerequisite: 310 or 320. McNabb. Nature and control of forest and shade tree diseases. Weekend field trips in northern and eastern Iowa. For satisfactory-fail credit only.

and stains of wood, including forest product pathologv. Field trips to local woods and lumber yards. For satisfactory-fail credit only.

414. Plant Ecology. (2-4) Cr. 4. F.S.SSI. Prerequisite: 203 or 306; Biol 308. Landers. Vegetation structure and function in relation to environment, community classification, succession, techniques, management of local vegetation, field trips.


490. Special Problems. (Biol 490) Cr. 2 to 5 each time taken. Prerequisite: Ten credits in botany and permission of instructor.
   A. Morphology.
   B. Physiology.
   C. Plant Pathology.
   D. Mycology.
   E. Taxonomy.
   F. Plant Ecology.
   G. Economic Botany.
   H. Honors Program.
   J. Cytology.
   K. Aquatic Plant Biology.

*Administered by the College of Agriculture. Courses not marked by an asterisk are administered by the College of Sciences and Humanities.

Courses Primarily for Graduate Students, major or minor, open to qualified undergraduates

500 Biology of Algae. (3-3) Cr. 4. F.(SSI. Lakeside Lab.) Prerequisite: Fifteen credits in biological science. Dodd. Role of algae in freshwater habitats, environmental factors affecting growth and reproduction, introduction to morphology of major groups of algae. Field trips. May be taken at Iowa Lakeside Laboratory with written permission of instructor.

505. Morphology of the Embryophyta. (3-3) Cr. 5. S. Prerequisite: Fifteen credits in biological science including 107. Farrar. Morphology, reproduction, and evolutionary trends in the bryophytes, pteridophytes, and gymnosperms. Modern concepts of phylogeny; origin of embryophytes; origin of angiosperms.

506. Principles of Mycology. (4-2) Cr. 4. F. Prerequisite: Fifteen credits in biological science. Tiffany. Morphology, cytology, and physiology of fungi; their relation to agriculture and industry.

511. Plant Nutrition. (3-0) Cr. 3. F. Prerequisite: 320, Phys 112, Chem 335. LaMotte, Nevins, Stewart. Mineral nutrition, water relations, and translocation in vascular plants.

512. Plant Growth Regulation. (3-0) Cr. 3. W. Prerequisite: 320, Chem 335. LaMotte. Vascular plant growth, correlative phenomena in development, and hormones involved in their regulation.

513. Plant Metabolism. (3-0) Cr. 3. S. Prerequisite: 320, Phys 112, Chem 335. Nevins, Stewart. Photosynthesis, respiration and other aspects of metabolism in plants.

514. Plant Morphogenesis. (3-0) Cr. 3. S. Prerequisite: 320, 404. Horner, LaMotte. Causal mechanisms underlying patterns of development.

517. Physiological Methods and Techniques. (0-8 or 9) Cr. 2 or 3. F. Prerequisite: Credit or classification in 511, or 512, or 513. Nevins. Research methods and techniques in plant physiology. Permission of instructor required for 2-credit option.


*541. Epidemiology and Control of Plant Diseases. (3-3) Cr. 4. F. Prerequisite: 407. Browning. Environmental and genetic control of disease development; theories of managing resistance genes and cultural practices to maximize natural control processes. Not for graduate majors in plant pathology.


559L Field Biology of Lower Green Plants. (See list of courses offered at the Iowa Lakeside Laboratory.)

564. Aquatic Plants. (2-6) Cr. 4. F. Prerequisite: 306. Wooten. Taxonomy, ecology, and morphological specializations of aquatic plants, with emphasis on vascular plants. Field trips.

*574. Plant Nematology. (3-3) Cr. 4. F. Prerequisite: 407 or 416 or 417. Norton. Morphology, anatomy, and life cycles of commonly encountered plant-parasitic nematodes; symptom expression; control; concepts.


580L Ecology and Systematics of Diatoms. (See list of courses offered at the Iowa Lakeside Laboratory.)

584. Advanced Plant Ecology. (2-3) Cr. 3. F. Prerequisite: 424. Landers. Theories and approaches to the study of vegetation from Clements to the most recent authors; plant succession and community stability. Field trips.

590. Special Topics. Cr. 2 to 5 each time taken. Prerequisite: Fifteen credits in botany, permission of instructor.
   A. Morphology.
   B. Physiology.
   C. Plant Pathology.
   D. Mycology.
   E. Taxonomy.
   F. Plant Ecology.
   G. Economic Botany.
   J. Cytology.
   K. Aquatic Plant Biology.

*591. Advanced General Plant Pathology. (4-3) Cr. 5. F. Prerequisite: 404, 407, 508, 509, 574; 511 or 512 or 513. Bessin. 300, Gen 300. Credit or classification in Stat 401. Representative plant diseases, plant disease concepts and processes, and literature review.


594. Phytoecography. (0-6 and two weekend field trips.) Cr. 3. F. Prerequisite: Fifteen credits of biological science, including Bot. 306; historical ecology recommended. Puhl. History and nature of the principal vegetational formations, particularly of North America. Origins of vascular flora; the Arctic-tundra flora; tundra florlas of the eastern and western U.S.; origins of grassland and desert floras; Pleistocene and recent floristic history of the North American vegetation.


*Administered by the College of Agriculture. Courses not marked by an asterisk are administered by the College of Sciences and Humanities.

Courses for Graduate Students, major or minor

605. Cytogenetics. (Gen 605) See Genetics.


628. Fine Structure of Plant Cells. (3-0) Cr. 3. S. Prerequisite: 404; Bio 428 or 529. Horner and Wildman. Structure and functions of cells and cellular components at various levels of evolutionary development.


*691. Advanced Plant Pathology. (2-0 or 0-6) Cr. 2 each term. Taken. Prerequisite: Permission of instructor.
A. Diseases Caused by Bacteria. Dudley.
C. Forest Tree Diseases. McNabb.
D. Laboratory in Virology.
E. Toxicology.
F. Clinical Diagnosis.

695. Advanced Plant Taxonomy. (2-3) Cr. 3. S. Prerequisite: 304, Gen. 360. Isely. Literature and philosophy of plant classification, processes of speciation in higher plants, sources and interpretation of data, research methods, and plant nomenclature.

696. Seminar. Meetings of botany staff and students to discuss recent literature and problems under investigation.
A. Morphology.
B. Plant Physiology.
C. Plant Pathology.
D. For all staff and students in botany and plant pathology.
E. Cell Biology (C Bio 698).
F. Ecology.

699. Research. (See preceding section.)

**Courses Offered at the Iowa Lakeside Laboratory

301L. (L101) Field Biology. (4-12) Cr. 4. SSI. A study of plants in natural environments; includes methods of identification, collection, and preservation as well as basic ecological concepts. Field trips. Must be taken concurrently with Zool. 302L.

424L. Plant Ecology. (8-24) Cr. 8. SSI. Prerequisite: 203 or 306; 309. Vegetation structure and function in relation to environment; community classification; succession; techniques; management of local vegetation; field trips.

490. Special Problems. (See preceding section.)

500L. (L109) Biology of Algae. (8-24) Cr. 8. SSI. Prerequisite: Fifteen credits in biological science. Dodd. Role of algae in fresh-water habitats; environmental factors affecting growth and reproduction; introduction to morphology of major groups of algae. Field trips.


564L. (L124) Aquatic Plants. (8-24) Cr. 8. SSI. Prerequisite: 306. Wooten. Taxonomy, ecology, and morphological specializations of aquatic plants, with emphasis on vascular plants. Field trips.


590. Special Topics. (See preceding section.)


699. Research. (See preceding section.)

**Written permission of the instructor is prerequisite to all courses offered at the Iowa Lakeside Laboratory. For current information concerning courses, registration, and housing, see the annual Iowa Lakeside Laboratory Bulletin. This bulletin is usually available from participating departments after February 15. Numbers beginning with L indicate numbers used by the University of Iowa.
Cell Biology


Undergraduate Study

A special program in cell biology is not offered for the baccalaureate. Undergraduates wishing to prepare for graduate study in cell biology should elect laboratory courses in bacteriology, botany, and zoology; an introductory course in genetics; mathematics through calculus; chemistry through organic; and one year of physics. C Bio 428 or 527 and 528 are recommended to qualified undergraduates desiring an introduction to this area.

Graduate Study

Work is offered for the degrees Master of Science and Doctor of Philosophy with major in cell biology under an interdepartmental cooperative arrangement. Minor work is offered to students taking major work in other departments.

Facilities and qualified staff exist in these departments for fundamental research in viral, procaryotic, and eucaryotic systems, and from the level of molecular biology and genetics to the cellular and organismal levels.

A student majoring in cell biology will choose a major professor from the graduate faculty. They will develop a program of study with the guidance of a committee nominated by the advisory committee and appointed by the dean of the Graduate College. Language requirements will be determined by the student’s program of study committee.

Because of the interdisciplinary nature of cell biology, many different courses may be applicable to the student’s program of study. A student is referred to the various physical, chemical, and biological listings in several departments and the following partial listing of courses that relate directly to cell biology.

An Sci 670; Bact 408; 575; 601, 602, 603, 615; 621; 645; 675; and 680; B & B 404, 405, 406 (or 501, 502, 503); 461; 511; 521; 561, 562, 574, 575; and 601; Bot 512, 513; 514; 629; 679, and 680; Food Tech 547; Gen 605, 615; 619, and 620; V An 511; V Pa 653; V Phy 367, 368; 512, 513, 667, and 668; VMPRM 626 and 629; Zool 529; 538; 639; and 650.

In addition, various departments offer a special topics course listed as 590.

Open for graduate minor credit: Cell Biol 428.

Courses Primarily for Undergraduate Students

428. Cell Biology. (Biol 428, Bot 428, Zool 428) (3-0 or 3-3) Cr. 3 or 4. F. Prerequisite: Fifteen credits in the biological sciences; organic chemistry. Permission of instructor for enrollment in laboratory. Viles. Biological organization and function at the cellular level.

Courses Primarily for Graduate Students, major or minor, open to qualified undergraduates

527, 528. Advanced Cell Biology. (B & B 527, 528; Bot 527, 528; Zool 527, 528) (3-6) Cr. 5 each. 527: F.; 528: W. Prerequisite: 527: Permission of Instructor; 528: Bowen, Outka, Viles. Structure and function of cytoplasm and nucleus; molecular architecture of intracellular differentiation.

590. Special Topics. Cr. var. Prerequisite: Permission of instructor.

Courses for Graduate Students, major or minor

698. Seminar in Cell Biology. (Bact 698, B & B 698, Bot 698, Gen 698, Zool 698) (1-0) Cr. 1. F.W.S. Prerequisite: Permission of instructor.

699. Research.

Ceramic Engineering

David R. Wilder, Head of Department

Professors: Dodd, McGee.
Associate Professors: Berard, Hunter, Jones, Rosauer.
Assistant Professors: Martin.

Undergraduate Study

For undergraduate curriculum in ceramic engineering, leading to the degree Bachelor of Science, see College of Engineering, Curricula.

Ceramic engineering deals with those products formed from natural and synthetic minerals which are rendered durable by a process of heat treatment at high temperatures. These include most of the nonmetallic inorganic substances manufactured into electronic components, glass of all types, porcelain enamels, abrasives, cements, ultra-high temperature resistant refractories, many materials of construction, and other similar products.

The ceramic engineer is concerned with the technical problems encountered in the research, de-
development, control, production, and use of these products and materials and 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 into research, production, equipment and plant design, or sales engineering, depending upon the capabilities and inclination of the individual.

Graduate Study

The department offers work for the degrees Master of Science, Master of Engineering, and Doctor of Philosophy with major in ceramic engineering, and minor work to students taking major work in other departments.

Prerequisite to major graduate work is the completion of a curriculum in ceramic engineering, ceramic technology, engineering, or physical science equivalent to that required of undergraduate students at this institution.

There is no foreign language requirement for the degree Master of Science or Master of Engineering.

For the degree Doctor of Philosophy the foreign language requirement may be met in one of the following three ways: (1) A score of at least 400 in each of two Educational Testing Service foreign language examinations (French, German or Russian); (2) A score of at least 600 in one Educational Testing Service foreign language examination (French, German or Russian); (3) One year of formal course work (nine quarter hours) in either French, German, or Russian with a grade of at least C may be substituted for an Educational Testing Service score of 400; two years of formal course work (18 quarter hours) for an Educational Testing Service score of 600.

Open to graduate students for minor credit only: 341, 342, 343, 351, 411, 412, 413.

Courses Primarily for Undergraduate Students

100. Orientation. (1-0) Cr. R; S.

201, 202, 203. Seminar. (1-0) Cr. R; Yr.

221. Ceramic Materials. (4-0) Cr. 4. F. Crystal structures of ceramic materials. Interaction of structure and defects with mechanical and thermal properties.


233. High-Temperature Technology. (3-3) Cr. 4. W. Prerequisite: Chem 142, 142L. Credit or classification in Phys 223. Principles and calculations involved in producing, measuring, and controlling the high-temperature environment and ceramic processing.

243. Polymers and Composites. (3-0) Cr. 3. S. Prerequisite: Chem 142 or 142L. Processing, properties, and engineering applications of polymers and composite materials.

300. Inspection Trip. Cr. R; S. Prerequisite: Junior ceramic engineering classification. One-week trip inspecting ceramic plants and studying industrial methods of production.

301, 302, 303. Seminar. (1-0) Cr. R; Yr.

341. High-Temperature Processes. (3-3) Cr. 4. F. Prerequisite: 233. Use of high-temperature treatment to effect atomic transport and densification through sintering and vitrification. Prediction of final fired structure by means of phase equilibrium diagrams.


343. Electronic Ceramics. (3-0) Cr. 3. S. Prerequisite: 221; credit or classification in EE 445. Fundamentals of semiconductivity, dielectricity, and magnetism in ceramic materials.

347. Ceramic Construction Materials. (3-0) Cr. 3. S. Prerequisite: 340. Correlation of the processing variables and the physical properties of the ceramic materials used in construction. Processing of glass, structural clay products, and composite materials. Primarily for architecture students.

351. Microstructure of Ceramic Materials. (1-6) Cr. 3. F. Prerequisite: 233. Characterization of ceramic materials from information obtained by microscopy and X-ray analysis.

353. Physical Property Measurements. (1-6) Cr. 3. S. Prerequisite: Credit or classification in 343. Thermal, mechanical, and electrical property determination in ceramic materials.


401, 402, 403. Seminar. (1-0) Cr. R; Yr.

411. Ceramic Industries I. (3-0) Cr. 3. F. Prerequisite: 342. Relationship of composition, crystal structure, fabrication techniques, and thermal processing to the properties of whitewares and technical ceramics.

412. Ceramic Industries II. (3-0) Cr. 3. W. Prerequisite: 351. Manufacture, properties, uses, performance, and testing of basic, neutral, and acid refractories.

413. Ceramic Industries III. (3-0) Cr. 3. S. Prerequisite: 342. Plant layout, processing, economic aspects, and structure of the enamel and glass industries. Inspection trip to porcelain enamel plant.

422. Ceramic Engineering Design. (1-9) Cr. 4. W. Prerequisite: 351. Introduction to the design of laboratory furnaces, production dryers, and production kilns.

423. Ceramic Engineering Design. (1-6) Cr. 3. S. Prerequisite: 422. Ceramic plant layout and design.

431, 432. Senior Project. 431: (2-6) Cr. 4. F; 432: (0-6) Cr. 2. W. Prerequisite: 351, 363. An individual ceramic development or research project designed by the student.

490. Special Problems. (0-3 to 15) Cr. 1 to 5. Introduction to research methods, investigation, and continuation of research problems for the undergraduate student. H. Honors.

Courses Primarily for Graduate Students, major or minor, open to qualified undergraduates.

512. Ceramic Technology. (3-0) Cr. 3. Offered as arr. Prerequisite: Permission of instructor. Physics and chemistry of inorganic glasses. Relationship of properties to composition and structure. Devitrified glasses. Melting, firing, and annealing.

513. Ceramic Technology. (3-0) Cr. 3. Offered as arr. Prerequisite: 342 or permission of instructor. Semiconducting, dielectric, and magnetic properties of ceramic materials and their interpretation with respect to composition and crystal structure.
Undergraduate Study

For curricula in chemical engineering leading to the degree Bachelor of Science and Master of Engineering, see College of Engineering, Curricula.

Chemical engineers are concerned with the processes and equipment for bringing about changes in the state of matter and for transforming energy. They make use of chemical and nuclear reactions and many physical operations such as mixing, distillation, crystallization, vaporization, andfiltration. They are trained in the fundamentals of science and mathematics as well as in the principles of fluid flow, heat and mass transfer, and in thermodynamics. They are usually employed by chemical and allied industries, but frequently make contributions in the electronic, nuclear, metallurgical, and aerospace industries; in the fields of biomedical and biochemical engineering; and in private and public research, and educational institutions. They are helping to solve important problems arising in the exploration of the ocean depths and of outer space, and are participating in the development of new devices for medical uses and new methods for processing information. They may be assigned specifically to design, construct, operate, and manage large manufacturing plants, or may work on the development of new products and processes, or may carry out basic research on the properties of matter or on systems used for processing matter and information.

Curricula in chemical engineering are designed to prepare students to enter the engineering profession at two levels. After completing a common first two years, students elect either the basic four-year practice option or an advanced, more science-oriented, five-year option which leads to the Master of Engineering degree. Both programs fully qualify the graduate to enter the profession. The practice option prepares the student for the more applied areas of chemical engineering such as manufacturing, plant design, and development. The science-oriented option better prepares the student for work in more analytical areas such as process design, systems analysis, and mathematical modeling. A bachelor's degree is awarded to students who complete the four-year requirements in either program, but those in the science-oriented five-year program normally continue for the fifth year if eligible for admission to the graduate college. Qualified graduates from either program may choose to work for advanced research-oriented graduate degrees.

A cooperative work-study program is available in the Chemical Engineering Department. See Cooperative Programs, College of Engineering.

Graduate Study

The department offers work for the degrees Master of Science, Master of Engineering, and Doctor of Philosophy with major in chemical engineering, and minor work to students taking major work in other departments.
Prerequisite to major graduate work is the completion of an undergraduate curriculum substantially equivalent to that offered in chemical engineering at this institution.

There is no foreign language requirement for the degrees Master of Science, Master of Engineering, or Doctor of Philosophy.

The department also participates in the interdepartmental program of water resources. (See Water Resources.)

Open to graduate students for minor credit only: 351, 352, 353, 343, 450, 451, 452, 454, 461, 462, 463, 471A,B, 472A,B, 473A.

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 labortarian on special problems.

201. Introduction to Chemical Engineering. (3-0) Cr. 3. W. Prerequisite: Credit or classification in Chem 142 and 142L. The application of stoichiometric principles to industrial processes.

202. Material and Energy Balances. (3-0) Cr. 3. S. Prerequisite: 201. Application of material and energy balance calculations to chemical engineering processes.

210. Chemical Processing. (3-0) Cr. 3. F. Prerequisite: Chem 142. Introduction to chemical processes involving chemical conversion and separation with emphasis on economic analysis, process design, and optimization. Consideration of typical as well as new processes to provide an overview of the chemical engineering function.

300. Junior Inspection Trip. Cr. R; S. Prerequisite: Junior classification in chemical engineering. Visits to chemical industries and plants in an industrial area for one week.

310. Engineering Unit Operations. (3-2) Cr. 4. F.S. Prerequisite: Chem 142, 142L, Math 213, Phys 222. Material and energy balances, fluid flow, heat and mass transfer, rate processes, stage operations, and system analogues.

315. Stoichiometry. (4-0) Cr. 4. F. Prerequisite: Math 213, Phys 222. Material and energy balances. Introduction to rate processes.

341. Computer Applications in Chemical Engineering. (2-3) Cr. 3. S. Prerequisite: 351, 352, Math 213. Applications of digital and analog computers to the solution of problems arising in transport processes, chemical reactions, process dynamics, and equipment design.

351. Multistage Operations. (4-0) Cr. 4. F. Prerequisite: 202. Application of principles in 201 and 202 and physical chemistry to multistage processes for separation of chemical components. Equilibrium stage analysis of distillation, extraction, absorption, and crystallization. Problems involving design and operation of multistage process equipment are considered.

352. Momentum Transport Operations. (4-0) Cr. 4. W. Prerequisite: 202, Math 213, Phys 221. Concepts of momentum and mechanical energy transport in fluids are studied by examining problems related to fluid friction, viscosity, piping systems, settling, and flow through porous media. The subjects of filtration, sedimentation, and nonNewtonian fluids are also given attention.

353. Energy Transport Operations. (3-0) Cr. 3. S. Prerequisite: 352 or EM 378. Consideration of thermal energy transfer problems which occur in the process industry. Principles developed in 352 are extended to conduction and convection of heat. Design of heat transfer equipment is a major topic. Radiant heat transfer is also covered.

401, 402, 403. Technical Seminar. (1-0) Cr. R; Yr. Discussion of current problems of importance to chemical engineers.

435. Process Control. (3-0) Cr. 3. W. Prerequisite: 341, 353, Math 321. Mechanisms used to control industrial processes: their applications and limitations. Dynamics of chemical process components and process control systems. Analog simulation of process systems.

450. Process Control Laboratory. (0-4) Cr. 2. W. Prerequisite: Credit or classification in 435. Experiments in chemical process dynamics and control. Measurement of system parameters, transient response, and frequency response. Simulation of control systems. Transient response of chemical process equipment.

451, 452. Chemical Engineering Laboratory. (0-6) Cr. 2 each. F.S. Prerequisite: Credit or classification in 454. Measurement of transport properties and rates of heat, mass, and momentum transfer; investigation of process equipment, unit operations, and chemical reaction systems. Treatment of data, reports, and equipment design.

454. Mass Transport Operations. (3-0) Cr. 3. F. Prerequisite: 353. The subjects of diffusion and mass transfer are studied in the context of chemical processes involving separation and synthesis. This course is an extension of 352 and 353. Problems of gas-liquid absorption, simultaneous heat and mass transfer, and chemical reactor technology are discussed.

461, 462. Chemical Engineering Thermodynamics. 461: (3-0) Cr. 3. W; 462: (3-0) Cr. 3. S. Prerequisites: 461: Math 223 or 233, Phys 222, 462: 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. F. Prerequisite: 462. Kinetics of chemical reactions, design of homogeneous and catalytic flow and batch reactors.

471A,B, 472A,B, 473A. Chemical Engineering Design. (1-6) Cr. 3 each. A sequence: F.W.S.; B sequence: W.S. Prerequisites: 471A,B: Credit or classification in 454, 463; 472A: 471A; 472B: 471B; 473A: 471A or B, 341. Principles of process and plant design; economic and feasibility analysis; application of feasibility techniques, optimization. B. Analysis, synthesis, and design of chemical engineering equipment, processes, and systems. Economic and feasibility analysis, optimization techniques.

490. Special Problems. (0-3 to 18) Cr. 1 to 6. Introduction to research methods; investigation of an approved topic. H. Honors.

Courses Primarily for Graduate Students, major or minor, open to qualified undergraduates

500. Individual Problems. Prerequisite: Major in chemical engineering. Investigation of an approved topic on an individual basis.

504. Polymers and Polymer Engineering. (3-0) Cr. 3. W. Prerequisite: Chem 355. Chemistry of polymers, addition and condensation polymerization. Physical and mechanical properties, polymer rheology, production methods. Fabrication and extrusion equipment operation. Applications of polymers in the chemical industry. Field trips to area plants.

515. Organic Chemical Industries. (3-0) Cr. 3. SS. Prerequisite: Chem 355. Chemical engineering aspects of manufacture of the principal organic chemicals.

516. Heavy Inorganic Chemical and Fertilizer Industries. (3-0) Cr. 3. SS. Prerequisite: Permission of instructor. Manufacture of commercial fertilizers and related heavy inorganic chemicals.

590. Biochemical Engineering. (3-0) Cr. 3. W. Application of basic chemical engineering principles in biochemical and biological process industries such as fermentation, food processing, enzyme technology, and biological waste treatment.

555. Process Dynamics. (3-0) Cr. 3. S. Prerequisite: 435. Applications of dynamic analysis techniques in the study of nonsteady state chemical processes.

541, 542. Calculation Methods for Chemical Engineers. (3-0) Cr. 3 each. F.W. Prerequisite: 541: 454, credit or classification in Math. 322; 542: 541. 541: Analysis and design of equipment and processes and the solution of the resulting differential equations by operational, series, and analog computer techniques. 542: Advanced analysis and design of equipment and processes by digital computer simulation and solution.

564, 555, 556. Advanced Unit Operations. (3-0) Cr. 3 each. Yr. Prerequisite: 454: 554: Momentum transport processes in fluid-solid systems. Derivation and analysis of the basic equations of change: laminar and turbulent flow; flow through packed towers and fluidization; flow past submerged bodies. 556: Energy transport processes. Steady-state and dynamic thermal processes, coupled energy and momentum transfer, and radiative transport. 564: Mass transfer. Diffusion theory, two-phase mass transfer, mass transfer efficiencies, coupled heat, and mass transfer.

565. Multistage Operations. (3-0) Cr. 3. S. S. Prerequisite: 561. General theory of multistage 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. S. S. Prerequisite: 561. Theory and application of solvent extraction to industrial processing.

573. Advanced Chemical Engineering Design. (1-6) Cr. 3. P. Prerequisite: 472B. Development of new designs for emerging areas such as environmental control, food processing, energy conversion, and life support systems.


562. Thermodynamics of Multi-Component Systems. (3-0) Cr. 3. W. Prerequisite: 561. Thermodynamic properties of solutions. Phase equilibria and chemical reaction equilibria.

588. Chemical Engineering Kinetics. (3-0) Cr. 3. S. Prerequisite: 483. Theory of absolute reaction rates; mass and heat transfer in catalytic beds; treatment of differential and integral conversion data.

590. Special Topics. Cr. 2 to 5 each time taken. A series of one-term courses chosen from such topics as catalytic reactor design, cost estimation, chemical engineering of nuclear processes, acid and base reactors, crystallization, polymerization, statistical thermodynamics, applied electrochemistry, and biotechnology.

643. Advanced Calculation Methods for Chemical Engineers. (3-0) Cr. 3. S. Prerequisite: 541. Advanced analysis and design of equipment and processes requiring specialized mathematical techniques.

699. Chemical Engineering Research.

Chemistry

John D. Corbett, Chairman of Department


Associate Professors: Clardy, Edgar, Franzen, Gerstein, Hoffman, Hutton, Trahanovsky.

Assistant Professors: Barton, Caider, Johnson, Small.

Instructors: Larock, Warner, Yeung.

Undergraduate Study

For undergraduate curriculum in sciences and humanities leading to the degree Bachelor of Science, see Sciences and Humanities, Curriculum.

Graduates in chemistry qualify in many fields: as teachers of chemistry, as analytical or control chemists, as supervisors in industry, as technical sales personnel, and as research chemists in federal, state, municipal, academic, or industrial laboratories.

Undergraduate chemistry students take not only studies in chemistry but also courses in mathematics, physics, German or Russian, and in cultural subjects. Students with the necessary high scholastic standing usually continue with graduate work, where they can explore more thoroughly the specialized areas of chemistry in which they are interested.

Undergraduate students of chemistry usually have the following basic courses or their equivalents in their programs: 114, 115, 120, 224, 301, 302, 303, 316, 325, 326, 327, 330, 331, 332, 333, and 6 credits of advanced chemistry. As supporting work undergraduate majors have found the following courses desirable: Math 130 (or 130A), 131, 132, 233; Phys 221, 222, 223. These lists of courses are not to be regarded as statements of fixed requirements or as complete outlines of the work necessary for the major. They are given solely for the convenience of students or advisers who wish to estimate the amount of basic, nonspecialized study which may be needed.

Courses for Graduate Students, major or minor

601. Seminar. (1-0) Cr. R. F.W.S.

631, 632, 633. Advanced Transport Phenomena. (3-0) Cr. 3 each. Alt. Yr. as arr. Prerequisite: 556; Math 322, 410. Advanced topics in the transport of momentum, energy, and mass; derivation and application of equations of change; thermodynamics of irreversible processes; statistical theories of turbulence; eddy diffusion; boundary layer theory; particulate systems; packed and fluidized beds; non-Newtonian systems; correlation of transfer coefficients.
Graduate Study

The department offers work for the degrees Master of Science and Doctor of Philosophy with majors in analytical, inorganic, organic, and physical chemistry, and in combinations thereof. Minor work is offered to students taking major work in other departments.

In cooperation with the Institute for Atomic Research, special facilities are offered to graduate students in other departments of the University who wish to use radioactive isotopes in their research. Analytical chemistry, calculus, and physics are required for this phase of chemistry.

The Department of Chemistry requires all graduate students majoring in chemistry to teach as part of their training for an advanced degree.

Prerequisite to major graduate work is the completion of undergraduate work in chemistry, mathematics, and physics, substantially equivalent to that required of undergraduate students at this institution.

Foreign language is not required for the M.S. degree. For the Ph. D. degree, the language requirement must be met from German, Russian, French, or in some special cases, Japanese. The minimum requirements depend on the area of study, as follows:

Analytical and organic students are required to pass one foreign language by ETS examination. Physical chemistry majors must pass two foreign languages (ETS) or one of the above languages plus a demonstration of proficiency in FORTRAN computer language (by course work or by a special examination) or one ETS examination at a high level of proficiency. Inorganic majors are required to pass German and may do so by ETS examination, by previous course work, or by passing a special reading examination.

Open to graduate students for minor credit only: 301, 302, 321, 322, 322L, 323, 323L, 334, 335, 336, 408, 426, 493, 494.

Index to field of work is given by the second and third figures of course numbers:

(a) Inorganic Chemistry 00 to 09.
(b) Analytical Chemistry 10 to 19.
(c) Physical Chemistry 20 to 29.
(d) Organic Chemistry 30 to 39.
(e) General Chemistry 40 to 49.
(f) Open 50 to 89.
(g) Special Topics 90.
(h) Physical Chemistry 91 to 94.
(i) Research 95 to 99.

For courses in biochemistry, biophysics, and metallurgy, see Index.

Courses Primarily for Undergraduate Students

114. Quantitative Analysis. (3-6) Cr. 5. F. Prerequisite: High school chemistry. Review of fundamental principles of chemistry with emphasis on chemical equilibrium, gas laws, and calculations. Theory and practice of gravimetric and volumetric analysis with particular attention to acid-base reactions. For students majoring in chemistry or biochemistry.

115. Quantitative Analysis. (3-6) Cr. 5. W. Prerequisite: 114 or 211. Theory and practice of volumetric analyses involving oxidation-reduction and precipitation reactions. Special emphasis on nondenotated ions. Theory of electrochemistry. Colorimetric methods of effecting separations. Design of analytical methods and evaluation of results. For students majoring in chemistry or biochemistry.

120. Chemical Structure and Bonding. (5-0) Cr. 5. S. Prerequisite: 116; Math 120 or 130. Atomic structure, molecular structure, molecular properties, and wave properties of the electron. Periodic structure of the elements. Qualitative introduction to modern understanding of chemical binding and molecular structure in metallic and nonmetallic compounds. For chemistry majors.

140. Foundations of Chemistry. (4-0) Cr. 3. F.S.SS. Prerequisite: Credit or classification in 140L. Basic methods and concepts of chemistry that a student must master before he is ready for other college chemistry. For students who have not taken high school chemistry or those with otherwise deficient backgrounds. The content of this course is approximately equivalent to a 1-year high school chemistry course.

140L Laboratory Foundations of Chemistry. (6-0) Cr. 1. F.S.SS. Prerequisite: Credit or classification in 140. Laboratory to accompany 140.

*141, 142. General Chemistry. (4-0) Cr. 3 each. 141: F.W.S.S.; 142: W.S.SS. Prerequisite: 141: High school chemistry or 140 and 140L, credit or classification in 141L; 142: 141, 141L. Principles of chemistry and properties of matter explained in terms of modern chemical theory.

*141L, 142L. Laboratory in General Chemistry. (3-0) Cr. 3 each. 141L: F.W.S.S.; 142L: W.S.SS. Prerequisite: 141L: Credit or classification in 141; 142L: 141L. Laboratory to accompany 141 and 142. 141L must be taken with 141; 142L is not a necessary corequisite with 142.

*147, 148. General Chemistry. (4-0) Cr. 3 each. 147F: 147: 4W. W. Prerequisite: 147: High school chemistry and credit or classification in 147L; 148: 147L. Chemistry explored at greater depth than in 141 and 142. May be elected by well-prepared students in all colleges. For students with strong interest in science-related fields.

*147L, 148L. General Chemistry Laboratory. (3-0) Cr. 1 each. 147L: F.W.S.S.; 148L: W. Prerequisite: 147L: Classification in 147L; 148L: 147L. Laboratory to accompany 147 and 148. 147L must be taken with 147; 148L is not a necessary corequisite with 148.

211. Quantitative Analysis. (3-6) Cr. 5. F.W.S.S. Prerequisite: 142L or 148L. Theory and practice of elementary gravimetric, volumetric, and colorimetric analysis.

224. Physical Chemistry. (3-0) Cr. 3. S. Prerequisite: 120; Math 122 or 132; Phys 112 or 222. Elementary thermodynamics and theory of the gaseous state. Homogeneous equilibria. For students majoring in chemistry or biochemistry.

231. Elementary Organic Chemistry. (3-0) Cr. 3. F.W.S.S. Prerequisite: 142L or 148L, credit or classification in 232. For students desiring a terminal course. Not recommended for students in physical or biological sciences. Students desiring a more rigorous course should take 334, 335, and 337. The department recommends credit in both 231 and 334 not be applied toward graduation.

232. Laboratory in Elementary Organic Chemistry. A, B: (0-6) Cr. 2 each. C: (0-3) Cr. 1. F.W.S.S. Prerequisite: Credit or classification in 231. A: Laboratory techniques including gravimetric analysis, volumetric analysis, and organic functional group analysis. B: Laboratory techniques in synthesis and qualitative organic analysis. C: Qualitative emphasis on chemical and physical properties of dyes, polymers, fats, and carbohydrates. Condensation of material covered in 232B.

301, 302. Inorganic Chemistry. (3-0) Cr. 3 each. 301: W.; 302: S. Prerequisite: 325 or 322. Bonding in inorganic systems; descriptive and systematic chemistry of the ele-
menta. Emphasis on correlation of structure and bonding with chemical and physical properties of inorganic compounds; applications of thermodynamics, kinetics, and other physical methods to study of inorganic systems.

309. Inorganic Chemistry Laboratory. (0-6) Cr. 2. S. To accompany 308. For students majoring in chemistry or biochemistry.

310. Quantitative Analysis. (3-6) Cr. 5. S. Prerequisite: 115, 326. Operational theory of the principles of instruments. Atomic and molecular absorption and emission spectroscopy. Potentiometry, volumetry, gas chromatography, liquid chromatography, mass spectrometry, nuclear magnetic resonance spectrometry. Literature of chemical analysis.

321, 322, 323. Physical Chemistry. (3-0) Cr. 3 each. 321: F.S.; 322: F.W.; 323: W.S. Prerequisites: 321: 211 or 142, Phys 223, Math 122 or 132 recommended; 322: 115, 322L, properties of gases, liquids, and solids; solutions; thermochemistry and thermodynamics; chemical kinetics; electrochemistry; atomic and molecular structure. Students majoring in chemistry or biochemistry ordinarily will elect 324, 325, 326, 327.

322L. Laboratory in Physical Chemistry. (0-3) Cr. 1. W. Prerequisite: Credit or classification in 322 recommended. Should accompany 322.

323L. Laboratory in Physical Chemistry. (0-6) Cr. 3. S. Prerequisites: 323L, credit or classification in 323 recommended. Should accompany or follow 323.

325. Physical Chemistry. (3-0) Cr. 3. F. Prerequisite: 224. Principles of quantum mechanics and spectroscopy.


327A, 327B. Laboratory in Physical Chemistry. (0-6) Cr. 3 each. 327A: F.; 327B: W.S. Prerequisites: 327A: 115, 327B: 327A. To accompany or follow 325 and 326. For students majoring in chemistry, chemical engineering, or biochemistry.

330. Laboratory in Organic Chemistry. (0-6) Cr. 2 each time taken. F.W.S. Prerequisite: 115. To accompany 331, 332, 333. For students majoring in chemistry or biochemistry.

331, 332, 333. Organic Chemistry. (3-0) Cr. 3 each. Yr. Prerequisite: 331: 120; 332: 331; 333: 332 or 335. For students majoring in chemistry and biochemistry. 331, 332: Chemistry of aliphatic and aromatic compounds. Polyfunctional and heterocyclic chemistry. 333: Modern research techniques and their use in organic chemistry.

334, 335, 336. Organic Chemistry. (3-0) Cr. 3 each. F.W.S. Prerequisites: 334: 335; 335: 336. S. Prerequisites: 142 and 142L, or 148 and 148L. Modern organic chemistry, including nomenclature, synthesis, structure and bonding, reaction mechanisms, physical methods, carbohydrates, proteins, and lipids. Premedical students will take this sequence. Students majoring in chemistry will ordinarily take 331, 332, 333.

337. Laboratory in Organic Chemistry. (0-6) Cr. 2. W.S. Prerequisite: Credit or classification in 335.

338. Laboratory in Organic Chemistry. (0-3) Cr. 1. S. Prerequisite: Credit or classification in 335.

398 Undergraduate Research. Cr. var. Prerequisite: Permission of staff member with whom student proposes to work.

408. Radiochemistry. (2-6) Cr. 4. F. Prerequisite: 142, Phys 223, Math 122. Radioactivity; theory, operation and use of radiation measuring instruments; principles of radiochemistry. For students in engineering.

420. Radiolabeling Methods. (2-6) Cr. 2. F. Prerequisite: 326 or 483; Phys 112. Radiolabeling techniques and their applications to problems in biology and allied sciences. For students in biology and agriculture.

490. Special Problems. Cr. var. Prerequisite: Permission of instructor.

493, 494. Biophysical Chemistry. (3-0) Cr. 3 each. 493: F.; 494: W. Prerequisite: Math 122 or 132. Physical chemistry with application to biological systems. Not accepted for credit toward a degree in chemistry or chemical engineering. 493 and 494 may be taken concurrently by those desiring laboratory.

499. Senior Research. (0-6 or 9) Cr. 2 or 3 each time taken. Prerequisite: Permission of staff member with whom student proposes to work. B average in all chemistry, physics, and mathematics courses. Research in chosen area of chemistry, with final written report as senior thesis. This course should be elected for three consecutive quarters just preceding graduation. For students majoring in chemistry.

Courses Primarily for Graduate Students, major or minor, open to qualified undergraduates.

500. Advanced Inorganic Chemistry. (3-0) Cr. 3. F. Prerequisite: 302. Concepts of structure, bonding, and chemical reactivity applied to inorganic compounds of the metallic and nonmetallic elements. For students not majoring in inorganic chemistry.

501. Inorganic Preparations. (0-6) Cr. 2. F. Prerequisite: 302. Preparation and characterization of inorganic and organometallic compounds by modern research techniques.

505. Physical Principles of Inorganic Chemistry. (3-0) Cr. 3. F. Prerequisite: 302 and 323 or 326. Theoretical concepts of bonding and structure applied to inorganic chemistry. Elementary group theory, hybridization and localized covalent bonding, molecular orbitals, and ligand field theory.

506. Application of Physical Methods in Inorganic Chemistry. (3-0) Cr. 3. W. Prerequisite: 505. Spectrometric, magnetic, and diffraction measurements in inorganic and organometallic research problems. Emphasis on stereochemical and bonding information.

507. Systematic Inorganic Chemistry. (3-0) Cr. 3. S. Prerequisite: 505, and 506 or 536 or 592. Descriptive chemistry of the metallic and nonmetallic elements.

510. Advanced Analytical Chemistry. (3-0) Cr. 3. F. Prerequisite: 316. Selected topics in modern quantitative analysis, including analytical separations, titrimetry, spectrophotometry, and other instrumental methods. For students not majoring in analytical chemistry.

511. Advanced Quantitative Analysis. (3-0) Cr. 3. S. Prerequisite: 319, and 323 or 326, and 333 or 336. General methods, descriptive inorganic analysis, and current literature.

512. Electrochemical Methods of Analysis. (2-3) Cr. 3. F. Prerequisite: 316, and 323 or 326, and 333 or 336. Principles and applications of electrochemical methods and mass spectrometry.

513. Molecular Absorption Spectrophotometry, (2-3) Cr. 3. W. Prerequisite: 316, and 323 or 326, and 333 or 336. Principles and analytical applications of absorption spectrophotometry.

514. Analytical Atomic Spectroscopy. (2-0) Cr. 2. S. Prerequisite: 323 or 326; Phys 223. Principles and experimental methods of optical emission spectroscopy, atomic absorption spectroscopy, and X-ray fluorescence spectroscopy.

515. Analytical Atomic Spectroscopy Laboratory. (0-6) Cr. 2. F.W.S. Prerequisite: 514. Laboratory in optical emission, atomic absorption, and X-ray fluorescence spectroscopy.

516. Quantitative Organic Analysis. (1-3 to 9) Cr. 2 to 4. W. Prerequisite: 333 or 336. 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. (0-3 to 12) Cr. 1 to 4. Prerequisite: Permission of instructor. Laboratory work on a special project in chemical analysis.

520. Advanced Physical Chemistry. (3-0) Cr. 3. W. Prerequisite: 323 or 326. Principles of physical chemistry as they apply to inorganic, organic, and analytical chemistry, including thermodynamics, kinetics, quantum mechanics, and spectroscopy. For students not majoring in physical chemistry.

521. Statistical Thermodynamics. (3-0) Cr. 3. F. Prerequisite: 323 or 326. Boltzman distribution, thermodynamics from a statistical viewpoint, Einstein and Debye crystals, ideal gases, equipartition theorem, kinetic theory, review of kinetics.

522. Chemical Thermodynamics I. (3-0) Cr. 3. W. Prerequisite: 323 or 326. Gases; solutions, homogeneous and heterogeneous equilibria.

523. Chemical Thermodynamics II. (3-0) Cr. 3. Alt. S. offered 1974. Prerequisite: 522. Applications to chemical systems.

524. Surface Chemistry. (3-0) Cr. 3. Alt. W., offered 1975. Prerequisite: 323 or 326. Basic principles and applications.


528. Chemical Kinetics and Mechanisms. (3-0) Cr. 3. S. Prerequisite: 323 or 326. Methods of studying reaction rates: stoichiometry, chain mechanisms from rate laws; reversible, consecutive, and competing reactions; chain mechanisms; exchange reactions; isotope rate effects; very rapid reactions; acid-base catalysis; theories of un-molecular reactions; absolute rate theory.

529. Laboratory in Radiotracer Techniques. (0-6) Cr. 2. W.S. Prerequisite: 426. Measuring and handling radioactive substances in chemical and biological experiments.

530. Advanced Organic Chemistry. (3-0) Cr. 3. S. Prerequisite: 333 or 336. Advanced organic chemistry. Topics in modern organic chemistry; including structure, reaction mechanisms, organic synthesis, and spectroscopy. For students not majoring in organic chemistry.

531. 532. Mechanistic Theory of Organic Chemistry. (3-0) Cr. 3 each. 531: W.; 532: S. Prerequisite: 323 or 326; 333 or 336. Organic reaction mechanisms, organic synthesis, stereochemistry of organic processes.

535. Advanced Organic Laboratory. (0-3 or more) Cr. 1 or more each time taken. F.W.S.S. Prerequisite: Permission of instructor. Staff member with whom work is to be done. Experimental techniques in organic chemistry.

536. Introduction to Organic Chemistry Research. (2-3) Cr. 3. F. Prerequisite: 323 or 326, and 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. Organic Reactions and Stereochemistry. (3-0) Cr. 3. F.S.S. Prerequisite: 323 or 326, and 333 or 336. Descriptive organic chemistry with emphasis on synthesis and stereochemistry.

590. Special Topics. (1-0) Cr. 1. Introduction to the various areas of current research in physical chemistry at Iowa State University.

591. Symmetry and Molecular Structure. (2-0) Cr. 2. S. Prerequisite: 323 or 326. Molecular symmetry, symmetry adapted wave functions, applications to the electronic structure of molecules and spectroscopy.

592. Chemical Bonding and Structure. (3-0) Cr. 3. S. Prerequisite: 323 or 326. Molecular symmetry elements, symmetry adapted wave functions, applications to the electronic structure of molecules and spectroscopy.

593. Chemical Spectroscopy and Structure. (3-0) Cr. 3. F. Prerequisite: 505 or 591. Interaction of radiation and matter; radio frequency, infrared, visible and ultraviolet spectroscopy.

594. Diffraction and Molecular Structure. (2-0) Cr. 2. F. Prerequisite: Permission of instructor. X-ray, neutron and electron diffraction: scattering by electrons, atoms, and molecules. Translation and point group symmetry, application of Fourier methods. Examples of structures deduced from diffraction techniques.

Courses for Graduate Students, major or minor

600. Seminar in Inorganic Chemistry. (1-0) Cr. 1 each time taken. W.S. Prerequisite: Permission of instructor.

601. Selected Topics in Inorganic Chemistry. (2 or 3) Cr. 2 or 3 each time taken. F.W.S. Prerequisite: 502. Topics such as chemical applications of group theory, molecular structure and bonding, organometallic compounds, physical techniques of structure determination, reaction mechanisms, and ligand field theory.

611. Seminar in Analytical Chemistry. (1-0) Cr. 1 each time taken. F.W.S. Prerequisite: Permission of instructor.

620. Seminar in Physical Chemistry. (1-0) Cr. 1 each time taken. W.S. Prerequisite: Permission of instructor.

621. Statistical Mechanics. (3-0) Cr. 3 each time taken. Alt. W.S., offered 1974. Prerequisite: Permission of instructor. Review of classical and quantum mechanics, principles of statistical mechanics, applications to thermodynamics and other related problems.

622. Quantum Chemistry. (3-0) Cr. 3 each time taken. Alt. W.S. offered 1975. Prerequisite: Permission of instructor. Schroedinger 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. Selected Topics in Physical Chemistry. (0-2) Cr. 2 each time taken. F.W.S. Prerequisite: 521 or 592. Topics such as atomic, molecular, and nuclear structure; surface chemistry; photochemistry; chemical kinetics; electrochemistry; phase rule.

626. Crystal Structure Analysis. (3-0) Cr. 2 each time taken. W.S. Must be started in winter. Prerequisite: Permission of instructor. X-ray and neutron diffraction as applied to the solid state, kinematic theory of diffraction, space group symmetry, applications of Fourier and least-squares methods, methods for phasing structural amplitudes, examples of structures deduced from X-ray and neutron studies.

631. Seminar in Organic Chemistry. (1-0) Cr. 1 each time taken. F.W.S.S. Prerequisite: Permission of instructor.

632. Selected Topics in Organic Chemistry. (2-0) Cr. 2 each time taken. F.W.S.S. Prerequisite: 532. Topics of current interest in organic chemistry such as electron spin resonance spectroscopy, nuclear magnetic resonance spectroscopy, mass spectropy, physical organic chemistry, photochemistry, natural products, organometallic chemistry, computer techniques, modern synthetic methods, mechanisms of reductions and oxidations, carbon, molecular orbital theory, heterocycles, free radicals, and kinetics.

699. Research. Prerequisite: Permission of staff member concerned.
Child Development

Samuel G. Clark, Chairman of Department

Professors: Coulson, Pease, Sunderlin, Swanson.
Assistant Professors: Anderson, Crase, Draper, Engel, Glass, Karas, King, Madera, Randall, Stockdale.

Instructors: Byler, Cherry, Culler, DeWitt, Dixon, Gales, Geddes, Graham, Herwig, Jones, Montgomery, Nelson, Osburn, Shaw, VanAuken.

Undergraduate Study

For undergraduate curriculum in child development leading to the degree Bachelor of Science, see Home Economics, Curricula.

The department offers work for the degree Bachelor of Science with options in (1) nursery school-kindergarten education; and (2) community services for children. Sophomores selecting the nursery school-kindergarten option must apply to and be accepted in the teacher education program.

Child development is the systematic study of how children grow and develop. Students in this curriculum may prepare for professional work with children and families in connection with nursery schools, kindergartens, hospital programs, settlement houses, welfare agencies, programs for handicapped or emotionally disturbed children, community programs for older children and youth, and special programs for disadvantaged groups. In addition, students interested in preparing for graduate work will be given the opportunity to elect appropriate courses. Opportunities are provided to observe and work with infants, preschool, and school-age children.

Graduate Study

The department offers work for the degrees Master of Science and Doctor of Philosophy with major in child development, and minor for students taking major work in other departments.

In addition to fulfilling graduate college admission requirements, the students should have substantial backgrounds in one of the following fields: child development, family relations, human biology, human nutrition, education, anthropology, psychology, and sociology.

A foreign language is not required for the degree Master of Science or Doctor of Philosophy. In individual cases, however, competence in one or more languages may be specified by the student's program of study committee.

Open to graduate students for minor credit only: 442, 443.

Courses Primarily for Undergraduate Students

129. Principles of Child Development. (3-1) Cr. 3. F.W.S.SSI. Processes and principles of growth and development during formative years within the context of cultural, educational, and familial influences. Directed observation of infants and children.

217. Professional Experiences With Children. (1-2) Cr. 2. F.W.S.SSI. Prerequisite: 129. Reservation required. Objective analysis of adult-child interactions and evaluation of feelings and attitudes, with emphasis on the professional role of the adult.

224. Development in Infancy. (3-2) Cr. 4. F.W.S. Prerequisite: 129 or Psych 230. Developmental characteristics during the first two years of life. Observation of infants.

226. Development in Early Childhood. (3-2) Cr. 4. F.W.S. Prerequisite: 129 or Psych 230. Application of principles of development to children ages 2 to 6 years. Observation in the nursery school and kindergarten.


240. Literature for Children. (4-0) Cr. 4. F.W.S.SSI. Prerequisite: 129. Selection and use of literature as it contributes to the total development of children from birth through 12 years of age.

318, 318L. Seminar; Study Tour. 318: (1-0) Cr. 1. W. 318L: Cr. 1. S. Prerequisite: 318: Junior classification; 318L: 318. Study and visit child and family centers, institutions, and agencies that service various socioeconomic-ethnic groups. Fee.

341, 341L. Activities and Materials; Laboratory Participation. 341: (3-0) Cr. 3; 341L: (0-4) Cr. 2. F.W.S.SSI. Prerequisite: 226 or 226; 341L: Classification in 341. Theories of play and principles underlying the selection of activities and the use of materials for children. 341L: Participation with children involving activities and materials.

369. Introduction to Child Development Research. (3-0) Cr. 3. F.W.S. Prerequisite: 224, 225, 226. Readings in child development research with emphasis on interpretation and application of research methods and statistical techniques.

417A. Supervised Teaching in Nursery School-Kindergarten. Cr. 8. F.W.S.SSI. Prerequisite: 443, classification in 417A or 418. Supervised teaching in a children's center. Written evaluation of the teaching-learning situation and intragroup relationships.

417B. Supervised Teaching in Child Centers. Cr. 8. F.W.S.SSI. Prerequisite: 443, classification in 417A or 418. Supervised teaching in a children's center. Written evaluation of the teaching-learning situation and intragroup relationships.

418. Group Work With Children. Cr. 8. F.W.S.SSI. Prerequisite: 443, classification in 417B. Reservation required. Experience in teaching a group of nursery school or kindergarten children.

442. Guidance of Children. (3-2) Cr. 4. F.W.S.SSI. Prerequisite: 341 or Ed 344A. Behaviors of children in groups. Principles and techniques of guidance applied to children in family and group situations. Participation experience with groups of children.

443. Planning and Administration of Programs for Children. (4-2) Cr. 5. F.W.S. Prerequisite: 442. Examination, evaluation, and development of programs for children. Principles and techniques involved in the planning and administration of such programs.

449. Professional Relations in Child Development. (2-0) Cr. 2. F.W.S.SSI. Prerequisite: 443. Interrelationships among child development personnel, family members and representatives of community agencies.

490. Special Problems. Cr. arr. Prerequisite: Twelve credits in child development, permission of department head and instructor. Consult department office for precourse work.

A. Child Development.
B. Nursery Education.
C. Community Services.
Courses Primarily for Graduate Students, major or minor, open to qualified undergraduates

500. Short Course. Cr. 1 to 3. S. Prerequisite: Permission of instructor. Concentrated group study of various educational problems in the field of child development.

525. Theories in the Education of Young Children. (2-3) Cr. 3. F. Prerequisite: 534. 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.


532. Infant Growth and Behavior. (2-2) Cr. 3. S. Prerequisite: 534. Advanced study of infant behavior and development; current research with infants; laboratory observation.

534. Principles of Growth and Development. (3-0) Cr. 3. F. Prerequisite: Nine credits in child development. Analysis of the developmental approach to the study of child behavior. Emphasis upon principles of development. Laboratory observation.

535. Theories of Child Development. (3-0) Cr. 3. W. Prerequisite: 534. Theoretical foundations of child development. Examination of major theories and the supporting research evidence.

540. The Child With Learning Disabilities. (3-0) Cr. 3. F.SSI. Prerequisite: Twelve credits in behavioral sciences. Guidance of the learning disabled child within the family and educational setting. Influence of learning malfunction on general development.

541. The Gifted Child. (3-0) Cr. 3. F.SSI. or SSII. Prerequisite: Twelve credits in behavioral sciences. Characteristics of children with superior abilities. Major emphasis placed on intellectual styles of operations, creativity, and strategies for enhancing development of talent.

542. The Disadvantaged Child. (3-0) Cr. 3. W.SSI. or SSII. Prerequisite: Twelve credits in behavioral sciences. Characteristics of children from culturally and emotionally impoverished climates. Major emphasis includes etiology of intellectual and emotional limitations and strategies for prevention and guidance.

548. Parent Education. (3-0) Cr. 3. S. Prerequisite: 534 or F.E. 570. Principles and procedures of instruction and evaluation in parent education.

549. Cross-Cultural Studies of Child Rearing Practices. (3-0) Cr. 3. S. Prerequisite: Three credits in anthropology, C D 634 or F.E. 575; or 9 credits in anthropology. An examination of current research on the child in a cross-cultural perspective.

566. Selected Research Methods in Child Development. (3-0) Cr. 3. F. Prerequisite: Credit or classification in Stat 430 or Educ 5525. Identification of research areas. Use of the observational, correlational, and experimental methods, and the application of selected research techniques in child development research. Experience in methods of data collection and analysis, interpretation and presentation of findings, and critical evaluation of research.

590. Special Topics. Cr. 1 to 4 each time elected. Prerequisite: Twelve credits in child development, permission of department head.

A. Child Development.
B. Nursery Education.
C. Community Services.

Courses for Graduate Students, major or minor


616. Seminar. Cr. arr. W.S.

618. Planning College Courses in Child Development. (3-0) Cr. 3. Alt. S., offered 1974. Prerequisite: 625. Selection, organization, and presentation of subject matter.

625. History and Philosophy of Child Development. (3-0) Cr. 3. W. Prerequisite: 534. History of child development; research centers; theories of early childhood education.


649. Dynamics of Parent-Child Relationships. (3-0) Cr. 3. S. Prerequisite: Fifteen credits in child development, psychology, and sociology. Analysis of theories applicable to the dynamics of parent-child interactions.


699. Research.

Civil Engineering

Carl E. Ekberg, Jr., Head of Department

Professors: Baumann, Carstens, Coughen, Cleasby, Demirel, Ellis, Handy, Hardy, Jellinger, Mickle, Morgan, Patterson, Sanders, Spangler.

Associate Professors: Brewer, Dougal, Elleby, Fung, Girton, Hoover, Dah-Yinn Lee, Ti-Ta Lee, Lohnes, Lubsen, Oulman, Sheeler, Young.

Assistant Professors: Austin, Dare, Klaiber, Martin, Merrill, Montag, Ring, Ward.

Instructors: Gurbuz, Oliver, Porter, Russo.

Undergraduate Study

For undergraduate curriculum in civil engineering leading to the degree Bachelor of Science, see College of Engineering, Curricula.
Civil engineering consists of the economic application of the laws, forces, and materials of nature to the planning, design, construction, maintenance, and operation of public and private facilities. Commonly included are transportation systems; bridges and buildings; water supply, pollution control, irrigation, and drainage systems; river and harbor improvements; dams and reservoirs. Civil engineering also includes the planning, design, and responsible execution of surveying operations, and the location, delimitation, and delineation of physical and cultural features on the surface of the earth. Research, testing, sales, management, and related functions are also a part of civil engineering.

Work on the campus is supplemented by inspection trips which furnish an opportunity for firsthand study of engineering work and industrial plants.

Graduate Study
The department offers work for the degrees Master of Science and Master of Engineering with majors in civil, municipal, sanitary, soil, structural, and transportation engineering; for the degree Doctor of Philosophy with majors in transportation, structural, and sanitary engineering; and minor work for students taking a civil engineering major.

Graduate study also includes the planning, design, and responsible execution of surveying operations, and the location, delimitation, and delineation of physical and cultural features on the surface of the earth. Research, testing, sales, management, and related functions are also a part of civil engineering.

Work on the campus is supplemented by inspection trips which furnish an opportunity for firsthand study of engineering work and industrial plants.

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. (1-6) Cr. 3. F. Prerequisite: Competence in algebra and trigonometry. Surveying for resource development including principles of surveying measurements, topography, traversings, plane table mapping, field astronomy, and staking of buildings, curves and earthwork.

211, 211A. Elementary Surveying. (1-6) Cr. 3. F.S. Prerequisite: Competence in algebra and trigonometry. Principles of surveying measurements, simple topography, site layout and traversing. 211A: Primarily for students in the College of Agriculture.

212. Photogrammetry, Mapping and Land Surveying. (2-3) Cr. 3. W. Prerequisite: 211. Introduction to photogrammetry. Mapping from stadia and aerial surveys. Land surveying.

213. Route and Higher Surveying. (1-6) Cr. 3. F.S. Prerequisite: 211. Theory and practice in curves, earthwork problems, and surveying astronomy.

214. Photogrammetry, Route and Land Surveying. (1-6) Cr. 3. W. Prerequisite: 211 or 211A. Introduction to mapping and photogrammetry. Simple curves and earthwork. Elementary public and private land surveys.

228. Sanitary Engineering in Environmental Control. (3-0) Cr. 3. W. Prerequisite: Phys 112 or 222, Biol 103. The sanitary engineer's responsibility in public health including control of communicable diseases, air pollution, and solid wastes. Organization, administration, and operation of regulatory agencies.

294. Professional Development L Cr. R. F. Oral reports and discussion of significant civil engineering achievements and related topics.

301. Cartography. (Geog 301) See Earth Science.

304. Hydrology. (2-2) Cr. 3. W.S.S. Prerequisite: Com S 201, Stat 105. Elements of hydrology: precipitation, infiltration, direct runoff, evapo-transpiration, groundwater and streamflow; data collection and analysis, engineering applications.

315. Geodetic Surveying. (2-3) Cr. 3. F. Prerequisite: 213 or 214 or Geol 301. Geodetic control surveys. Precise triangulation; trilateration, traversing, and leveling. Geodetic computation on the ellipsoid. Design of geodetic surveys for various applications. Introduction to adjustment theory.

325. Water and Wastewater Treatment. (2-3) Cr. 3. W. Prerequisite: Chem 142, Math 223 or 233, Phys 221. Elements of design and operation of water and wastewater treatment systems, including physical, chemical, and biological treatment methods.


331A. Analysis of Statically Determinate Structures. (2-2) Cr. 3. F.S. Prerequisite: E M 325. Calculations of loads, reactions, shears, and moments in components of

350. Collaborative Transportation Development. (3-0) Cr. 3. F.S. Prerequisite: Three credits of statistics, junior classification. History, legal requirements, organizations, and coordination in national, state, and local development of transportation modes. The planning, regulation, safety, operation, and circulation patterns of air, rail, water, pipeline, street, and road systems. Population, land use, economic, social, and other source data for use in the location of transportation routes, parking, and terminal facilities.

352. Planning of Transportation Facilities. (3-0) Cr. 3. W.S.S.S. Prerequisite: Stat 101 or 105, and credit or classification in 213, or 214. Introduction to planning for systems of highway, rail, air, water, and pipeline transportation. Selection of route and mode based on economic and social factors, technological characteristics, and other factors. Transportation terminals.

360. Soil Engineering. (3-0) Cr. 3. F.W.S. Prerequisite: Geol 301, credit or classification in E M 324. Introduction to basic soil engineering; soil structure, soil mineralogy, soil water systems, and interactive forces; principles of settlement and shearing stresses in soils; application of soil engineering in embankments, retaining walls, foundations, piles and underground conduits.

361. Soil and Aggregate Materials Laboratory. (0-6) Cr. 3. F.W.S. Prerequisite: Geol 301, credit or classification in E M 324. Introduction to soil and aggregate materials testing. Identification and classification tests of engineering soils and aggregates. Physical and chemical properties tests of soil-granular systems.

362. Design of Concrete and Stabilized Soil Systems. (3-0) Cr. 3. F.W.S. Prerequisite: 361, or 301, E M 354. Physical and chemical properties of bituminous, portland, and other cements. Design and testing of concrete and stabilized soil systems. Admixtures. Mixing, handling, placing, and curing.

385. Professional Development II. Cr. R. W. Oral reports and discussions of prominent engineers and civil engineering solutions to problems of society.

404. Engineering in Urban Development. (3-0) Cr. 3. W. Prerequisite: 350 or 352. Relation of transportation, sanitary works, drainage, and other utilities to urban development; surveying and mapping requirements; housing; building codes.


414. General Photogrammetry and Photo-Interpretation. (For 414) See Forestry.

417A. Legal Aspects of Surveying. (3-0) Cr. 3. W. Prerequisite: 213. Legal aspects. Case studies in litigation involving surveys. Deed descriptions and recording. Zoning, subdivision and real estate law.

417B. Land Surveying. (3-0) Cr. 3. S. Prerequisite: 213. Methods used in original public land surveys. Boundary retracement. Subdivision layout.


Courses Primarily for Graduate Students, major or minor, open to qualified undergraduates

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| 520. Water and Waste Water Analysis. | (0-9) Cr. 3 to 6. W. Prerequisite: 425, and Chem 114 or 211. Review of the principles of gravimetric, volumetric, and colorimetric methods of analysis. Application of these principles to the laboratory analysis of water and wastewater samples. |
| 522. Water Pollution Control Plant Design. | (3-3) Cr. 3. S. Prerequisite: Biol 101, credit or classification in 427. Investigation and planning activities used to evaluate need for water pollution control facilities and design of such facilities. |
| 523. Water Treatment Plant Design. | (2-3) Cr. 3. W. Prerequisite: 426, credit or classification in Chem 211. Investigation and planning activities used to evaluate adequacy of existing municipal water supply and treatment facilities. Design of municipal water treatment facilities. |
| 525. Advanced Treatment of Water and Wastewater. | (2-3) Cr. 3. S. Prerequisite: 325, and Chem 114 or 211. Physical-chemical processes in water and waste treatment. |
| 528. Fundamentals of Biological Waste Treatment. | (3-3) Cr. 3. F. Prerequisite: 520, Chem 334, Bact 300. Relationship of the fundamentals of biological growth to the design and operation of biological waste-treatment systems. Characterization of wastes relative to their treatability and the selection of appropriate processes for their treatment. |
| 529. Low-Level Radioactive Wastes. | (3-0 to 9) Cr. 3 to 6. S. Prerequisite: Nuc E 510 or Chem 408. Sources of radioactive wastes. Principles of handling, treating, and disposing of low-level wastes which arise from nuclear energy operations. |
| 532. Structural Analysis by Numerical Procedures. | (3-0) Cr. 3. W. Prerequisite: 432. Analysis of structural problems by methods of successive approximations and numerical procedures; moments and deformations of beams, influence lines, moments and deflections of beams under combined axial and bending loads, buckling strength of columns and frames, beams on elastic foundations. |
| 534. Advanced Structural Analysis. | (3-0) Cr. 3. F. Prerequisite: 432, credit or classification in Math 321. Analysis of framed structures by force and displacement methods; energy principles; treatment of nonprismatic members, semi-rigid connections, foundation settlements, temperature changes, composite structures. |
| 535. Bridge Design. | (3-0) Cr. 3. F. Prerequisite: 433, 434. Superstructure and substructure design. Design of simple span and continuous span bridges, including slab, slab beam and slab, and truss types. Introduction to orthotropic steel plate deck bridges. |
539. Prestressed Concrete Structures. (3-0) Cr. 3. W. Prerequisite: 434. Principles of prestressed concrete with applications to structural design.


545. Behavior of Metal Structures. (3-0) Cr. 3. W. Prerequisite: 433. 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. 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. Plate and Shell Type Structures I. (3-0) Cr. 3. S. Prerequisite: 434, E M 514, Math 322. Bending and buckling of thin plates. Plate analysis by finite differences and finite elements. Folded plate construction. Analysis of cylindrical shells and shells of revolution by membrane theory.

551. Highway Economics and Finance. (3-0) Cr. 3. F. Prerequisite: 352 and Econ 242; or Econ 405 or 1 Ad 463 or 1 E 304. Highway revenue sources, apportionment to different levels of government, allocation of taxation between highway users and nonusers and among classes of users. Principles of economic analysis for highway improvements, pertinent market and nonmarket benefits and costs, methods of analysis.

553. Traffic Engineering Planning and Analysis. (3-3) Cr. 4. F. Prerequisite: Credit or classification in 453. Human and vehicular characteristics related to traffic; traffic characteristics; highway capacity; traffic studies and analysis of data; principles of traffic planning, forecasting techniques, and mass-transit planning.

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 Agency Administration and Management. Cr. 3. F. Prerequisite: 552 or Pol S 471. Organization of the highway function at national, state, and local levels; administrative procedures for highway planning, design, construction, operation, and maintenance. Management principles applicable to the highway function of governments and public authorities.

556. Airport Planning and Design. (3-3) Cr. 4. S. Prerequisite: 453. Airport planning including financing, forecasts of aviation activity, site selection, zoning; operation of landing and terminal areas; drainage, geometric, and structural design of runway, taxiway, and aprons.

560A. Soil Mechanics I. (3-0) Cr. 3. F. Prerequisite: 360. Advanced treatment of theory and principles of engineering soil mechanics as related to permeability, capillarity, seepage forces, stress distribution, effective stresses, and shear strength.

560B. Soil Mechanics II. (3-0) Cr. 3. W. Prerequisite: 560A. Advanced soil mechanics. Slope stability, earth pressures, bearing capacity, piles, and underground conduits.

562. Aerial Interpretation of Engineering Soils. (2-8) Cr. 4. S. Prerequisite: 360 and Geol 301 or 302. Recognition, identification, and mapping of engineering soils from airphotos. Site evaluation; material reconnaissance; principles and applications of infrared, radar, microwave technology; field checking.

563. Advanced Soil Engineering Laboratory. (2-3) Cr. 3. W. Prerequisite: 565. Analysis of engineering soils and crystalline materials by X-ray diffraction, differential thermal, and thermogravimetric methods.

564. Advanced Soil Engineering Laboratory. (1-6) Cr. 3. S. Prerequisite: 560A. Triaxial shear, consolidation, permeability, capillarity testing and analyses; relation of hydrostatic excess pressures to compositional influences. Field load tests.

565. Stability of Soil Materials. (3-0) Cr. 3. F. Prerequisite: 360, 362. Physico-chemical factors affecting soil stability; clay minerals, clay colloid chemistry and effect of chemical additives such as portland cement, lime salts, and resins.


568. Bituminous Paving Materials. (3-3) Cr. 4. W. Prerequisite: 362. Source, manufacture, processing, types, constituents, tests, chemical behavior, specifications, and uses of bituminous materials and aggregates in pavement. Laboratory tests.

569. Pavement Design. (3-0) Cr. 3. S. Prerequisite: 567. 568. Design of flexible and rigid pavements.


573. Ground Water Hydrolgy. (3-0) Cr. 3. S. Prerequisite: 304, E M 378. Study of ground water as a source of municipal, industrial, and agricultural water supplies; location, occurrence, hydrodynamics of flow; determination of aquifer and well characteristics, well discharge and pumping test analyses.

574. Multiple Use of Water Resources. (2-3 to 12) Cr. 3 to 6. W. Prerequisite: 304. Social, economic, and technical phases of governmental participation in public works programs in the field of water resources. Study of multi-purpose uses in water resources project planning.

585. Highway Construction Methods. (2-2) Cr. 3. F. Prerequisite: 362, credit or classification in 485. Methods and equipment used in processing materials and constructing highways and their appurtenances; scheduling and controlling operations; compliance with specifications.

586. Heavy Construction Methods. (2-3) Cr. 3. W. Prerequisite: Credit or classification in 485. Methods and equipment employed in heavy construction including pile, caissons, heavy foundations, piers, cofferdams and river works, heavy concrete structures, retaining walls, tunneling, and dam projects.

590. Special Topics. Cr. 1 to 5 each time elected.

Courses for Graduate Students, major or minor

582. Advanced Topics in Water Pollution Control. Cr. 3 to 6. Alt. F., offered 1974. Prerequisite: 582. Study of advanced concepts in water pollution control. Analysis and application of current developments to pollution control methods.

*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 AND PROGRAMS


634. Cable-Supported Structures. (3-0) Cr. 3. W. Prerequisite: 534, E M 345. Comparison of analyses by elastic theory, conventional deflection theory, and difference equation methods as applied to suspension bridges. Consideration of other types of cable-supported structures.

644. Space Frames. Cr. 3 to 6. F. Prerequisite: 534. Analysis of complete structures in three planes, including the continuous-frame and the truss-frame types.

648. Dynamic Analysis of Structures. Cr. 3 to 6. S. Prerequisite: 533 or 536; E M 345. Single and multidegree systems, linear and nonlinear systems, arbitrary disturbances, continuous and lumped mass systems, numerical and phase plane solutions, modal analysis, formulation by flexibility and stiffness matrices, response spectra, analysis and design for earthquake, wind, nuclear blast, and moving vehicles.


653. Street and Urban Highway Design. (3-3) Cr. 4. W. Prerequisite: 553. Design of city streets, involving cross section, intersections, subsurface utilities, on-and off-street parking, mass transportation, loading facilities, widening, channelization, drainage, and markings; design of urban expressways, service roads and their relationship to basic street system.

654. Highway Location and Design. (3-3) Cr. 4. S. Prerequisite: 554. Route selection, geometric design, economic aspects, traffic capacity, and roadway appurtenances of nonurban roads and highways.

655. Planning Transportation Systems. (3-0) Cr. 3. Alt. S., offered 1975. Prerequisite: 553. Coordination of transportation systems. Regional planning, planning surveys, designation of road and street systems. Mass transportation and location and type of urban facilities.

660. Foundations and Underground Structures. (3-0) Cr. 3. S. Prerequisite: 560B. Advanced foundation analysis and design to meet various soil conditions. Review of recent literature. Field investigation. Case histories.

663. Earth Dams. (3-0) Cr. 3. Alt. S., offered 1974. Prerequisite: 560B. Location, selection of material, design, and construction of earth dams. Field trips.


671. Advanced Topics in Water Resources Engineering. (A & E 571) (3-0) Cr. 3. Alt. S., offered 1974. Prerequisite: 571; 472 or A & E 424; Stat 401. Study of advanced concepts and experimental techniques used in solving water resources engineering problems. Application of simulation methods, mathematical models and advanced research methods in areas of hydrology, hydraulics of water control facilities, and water-resources development.

699. Research.

Climatology

For program in agricultural climatology, see College of Agriculture—Curriculum in Agromony, and Agronomy—Courses and Programs.

Computer Science

Robert M. Stewart, Jr., Chairman of Department

Professors: Keller, Lambert, Maple.

Associate Professors: Brearley, Grosvenor, Hutton, Jepson, Mosier, Stevens, Zingg.

Assistant Professors: Oldehoeft, Ostendorf, Silverston, Strawn, Thomas, Ulrichson, Wright.

Instructors: Bowman, Jordan, Smith.

Undergraduate Study

For undergraduate curriculum in sciences and humanities, major in computer science, leading to the degree Bachelor of Science, see Sciences and Humanities, Curriculum.

The curriculum in sciences and humanities with major in computer science is designed to prepare students for graduate study in computer science, or for positions as computer scientists with business, industry, or government. Areas of emphasis exist in programming language structure, systems programming, numerical analysis, statistics, computer systems engineering, information systems, and simulation.

The requirements for an undergraduate major in computer science include the following: 40 credits in computer science, some of which are specified by the computer science department with the remainder selected by the student; 19 credits in mathematics starting with Math 120 or 130 and selected from a list specified by the computer science department; and 18 credits in natural science and statistics. For additional requirements, see the computer science department.

It is recommended that majors include in their programs of study a strong minor in a field of application of computer science and, particularly for those who plan on graduate study, one or two years of French, German, or Russian.

The following courses are not acceptable for major credit by computer science majors: 447, 470, 471, 484.

Graduate Study

The department offers work for the degrees Master of Science and Doctor of Philosophy with major
in computer science and minor work to students majoring in other departments.

Facilities exist for fundamental research in such areas as numerical solution of ordinary and partial differential equations, computational methods of linear algebra, the theory of approximation, logical design and programming systems, switching theory, the theory of computer organization, programming language theory, and computer-assisted instruction.

A student desiring to do graduate work with a major in computer science should have completed a bachelor's degree or equivalent in computer science, or in a related area such as mathematics, statistics, physics, or electrical engineering. He or she should have a strong background in mathematics including some work in algebra, analysis, logic, and probability. Students who do not have these prerequisites should plan to complete them in addition to the regular course requirements for the advanced degree.

For the degree Master of Science, 45 quarter credits are required. Normally this is all in course work, but in some cases it will include preparation of a thesis recommended by the student's committee. If no thesis is presented, the preparation of a paper demonstrating ability to organize and express significant ideas in computer science is required. None of the 45 credits may be satisfied by the preparation of the paper. Foreign language is not required.

For the degree Doctor of Philosophy, the foreign language requirement may be satisfied in one of two ways: (1) Significant competence in one language. This competence may be evidenced by satisfactory completion of two years of college-level study of the language. (2) Reading ability in two languages. Ability in each language may be evidenced by satisfactory (a grade of C or better) completion of one year of college-level study of the language. In exceptional cases the candidate's committee may authorize the passing of a standardized foreign language examination in lieu of a formal college-level course in the language.

The languages will normally be selected from French, German, or Russian, although the candidate's committee may authorize other choices. The committee of a student whose native language is not English may substitute the ability to communicate in English for one of two languages.

The Department of Computer Science recommends that all graduate students majoring in computer science teach as part of their training for an advanced degree.

Additional work is usually required in mathematics, statistics, electrical engineering, or certain other fields.


Courses Primarily for Undergraduate Students

100. Perspectives in Computing. (2-0) Cr. 2. W. Computer systems and programming languages with emphasis on the relationship of computing to other fields of human activity. Not to be taken with or after 201. Offered on a satisfactory-fail basis only.

201, 202. Computer Programming. (3-0) (4-0) Cr. 3 and 4 respectively. 201: F.W.S.SSI.; 202: W.S. Prerequisite: 201: Math 104 or 109, sophomore classification; 202: 201. Introduction to computer organization and programming concepts, flow charts, algorithms, programming in procedure-oriented languages, elementary data structures, considerations of efficiency of programs, debugging, and verification of programs. 201 is suitable as an introductory one-quarter programming course.

301. Machine and Assembler Language Programming. (3-0) Cr. 3. F.S. Prerequisite: 202. Introduction to digital computer structure and machine language programming, internal representation of data, assembler language.

381, 382. Data Structures. (4-0) Cr. 4 each. 381: F.W.; 382: W.S. Prerequisite: 381: 301; 382: 361. Relationship between problem solving and data representation. Introduction to data structures through use of an appropriate programming language.

371. Algebraic Languages and Compilers I. (3-0) Cr. 3. F.S. Prerequisite: 202. Algebraic language syntax and semantic definition; Backus Naur Form; analyzer algorithms.

372. Algebraic Languages and Compilers II. (3-0) Cr. 3. W.S. Prerequisite: 371. Precedence grammars, compiling techniques, code generation, run-time storage allocation, handling of arrays and structures.


441A, 441B. Business Data Systems I, II. (3-2) Cr. 4. F.S. Prerequisite: 1 Ad 371 or 384. A course in computer science is recommended. Ostendorf introduction to computer-oriented business data processing; business programming languages; basic data file processing and reporting. For students interested in studying computer concepts through applications and a business-oriented computer language (COBOL). 441A: For computer science majors and other students with more than seven previous computer science credits 441B: For other students.

442. Business Data Systems II. (3-2) Cr. 4. W. Prerequisite: 441B. Ostendorf Application of programming and systems to business data processing, including data organization, development, control, storage, sequential file processing, file design and various types of reporting. Should not be taken for credit by students with credit in 441A.

443. Business Data Systems III. (2-2) Cr. 3. & Prerequisite: 441A or 442. Ostendorf Data-processing activities: types of input-output, configuring computer systems, data base concepts, information systems concepts, computer language and operating systems considerations in business data processing, data-processing center organizational structures and functions.

447. Introduction to Computers for the Biological Research Worker. (V Path 447) (3-0) Cr. 3. F. Prerequisite: Fifteen credits in biology or graduate classification; permission of instructor. Mitchell Data coding and use of unit record equipment. Logical basis of a digital computer system. Programming of data editing and record-keeping procedures using a higher-level language.


471. Data Processing and Programming for Behavioral Sciences. (3-0) Cr. 3. W. Prerequisite: 470. Use of data-processing techniques and the computer as research tools. Higher-level language programming and use of mathematical and statistical library programs.


481, 482. Processing of Statistical Data. (Stat 481, 482) See Statistics.


490. Special Problems. Cr. var. Prerequisite: Permission of instructor.

495. Seminar. Cr. var. F.W.S. Prerequisite: Permission of instructor.

Courses Primarily for Graduate Students, major or minor, open to qualified undergraduates

501, 502, 503. Theoretical Foundations of Programming Languages and Operating Systems. (3-0) Cr. 3 each. Yr. Prerequisite: 372, 457. Theoretical foundations of programming languages; language-defining mechanisms; semantic approaches (state vectors, lambda-calculus models, data-structure models); model languages. Theory and principles in the structuring of operating systems: overall structure, executive and monitor programs, queuing theory, processor allocation (scheduling algorithms), memory management (paging, segmentation, sharing, linking), file systems, system performance, loosely connected parallel processes.


530. Modelling and Simulation Techniques. (3-0) Cr. 3. F. Prerequisite: 202, Math 213. Development of mathematical models and simulation experiments with emphasis on simulator verification. Use of analog, digital and hybrid computers, and special-purpose languages.

551, 552, 553. Structure and Processing of Information. (3-0) Cr. 3. Yr. Prerequisite: 362. Jeppesen. Formalisms necessary to represent the structure and manipulation of information. Information coding for storage and retrieval, fixed and variable length information records; vectors and arrays; trees and list structures. Processing of structured information. Search, sort, and merge operations involving the characteristics of the storage media available in a computer system. Characteristics of programming languages for processing information structures; study of at least one current information processing language.


582. Switching Theory. (E E 582) See Electrical Engineering.


590. Special Topics. Cr. var. Prerequisite: Permission of instructor.

Construction Engineering

Thomas C. Jellinger, Professor In Charge
Assistant Professors: Ward, Martin.
Instructor: Russo.

Undergraduate Study

For undergraduate curriculum in construction engineering leading to the degree Bachelor of Science, see College of Engineering, Curricula.
The Department of Civil Engineering provides a curriculum for those students who are interested in construction engineering. This an area requiring specialists with a strong fundamental knowledge of engineering, plus management ability and familiarity with business, economics, and human behavior. The graduate of this program may be engaged in supervising the craftsmen and laborers on the job, ordering materials and equipment, making estimates, insuring the most rapid progress of the project, and keeping cost records. The program in construction engineering offers much of the background that contractors need. It blends engineering, management, and business administration to achieve this. Three emphases are available to the student in the construction engineering curriculum. These are building construction, heavy construction, and mechanical construction. An interdepartmental program is offered with major in industrial administration and minor in construction engineering for those students whose primary interest is in residential construction and/or materials supply.

Graduate Study

The construction engineering program includes the following courses, open to graduate students for minor graduate credit only: 355, 371, 372, 440, 441, 450, 490.

Courses Primarily for Undergraduate Students

100. Technical Lecture. (1-0) Cr. R; S. An examination of the nature, scope, and extent of the construction industry: an overview of the educational preparation necessary for the constructor in contemporary society.

241. Analysis of Materials and Methods of Construction. (3-0) Cr. 3. F.W. Prerequisite: Second year classification. Systems of construction including wood frame, wall bearing, skeleton frame, and the materials used in these systems. Methods and materials used in heavy construction and selection of equipment.

245. Construction Specifications. (3-0) Cr. 3. F.W.S. Prerequisite: 241 or Arch 343. Preparation and interpretation of construction specifications and other contract documents.


355. Real Estate Finance. (1 Ad 355) See Industrial Administration.

371. Contractors Organization. (3-0) Cr. 3. F.W. Prerequisite: 246. Construction contracting business management: planning, organization, staffing, directing, controlling.

372. Construction Planning and Progress Scheduling I. (0-6) Cr. 3. W.S. Prerequisite: 371. Types of progress schedules used in construction work. Applications and advantages of types of schedules. Principles of planning construction site layouts along with methods used in field inspection.

400. Senior Seminar. (1-0) Cr. R. F. Prerequisite: Senior classification. Required seminar for senior students. Discussion relating to professional registration, interview techniques with employment opportunities, and current problems relating to the construction industry.


441. Construction Planning and Progress Scheduling II. (0-6) Cr. 3. W. Prerequisite: 372, Com S 201. Analysis and application of advanced scheduling techniques including a study of computer methods with work in manpower leveling, equipment allocation, and time-cost relationships.

450. Quantitative Methods in Construction Management. (3-0) Cr. 3. S. Prerequisite: 441, Com S 201, Stat 105. Analysis of construction management problems using mathematical and statistical techniques; adaptation of utility and risk functions and linear programming to construction management: decision making, statistical bidding, theory and application of bidding strategy.

490. Special Problems in Construction Engineering. Cr. 2 to 5 each time taken. Prerequisite: 372, permission of professor in charge of construction engineering. Advanced problems in construction engineering with emphasis in the field of construction operations and in the field of engineering and technology.

Crop Science

For description of courses, see Agronomy.

Dairy Science

For description of courses, see Animal Science.

Design Center

Advisory Council: Clair B. Watson, Chairman; Thomas A. Barton, Martin D. Gehner.

The Iowa State University Design Center is an association of the departments of Applied Art, Architecture, and Landscape Architecture. These departments offer major undergraduate and graduate programs for those students who have a serious
interest in design and a dedication to the social
and cultural well-being of man's environment.
The major areas of education offered by the Design
Center departments are:
Department of Applied Art
  Advertising Design
  Art Education
  Craft Design
  Interior Design
Department of Architecture
  Architecture
  Urban Design
Department of Landscape Architecture
  Landscape Architecture
  Urban Planning
  Town and Regional Planning
Details of each curriculum will be found in the
appropriate departmental section.

Courses Administered by the
Design Center.

*125. Understanding the Environmental Arts. (3-0) Cr. 3.
  F. Western culture, with selections from primitive to
  contemporary cities, reflecting the interrelationships of
  architecture, landscape architecture, urban design, painting,
  sculpture, and related arts.

*126. Understanding the Environmental Arts. (3-0) Cr.
  3. W. The design process examined to relate the materials
  of the artist and designer to the culture of
  his era.

*127. Understanding the Environmental Arts. (3-0) Cr.
  3. S. Non-European culture with significant examples of
  the interrelationships of architecture, landscape architect-
  ure, urban design, painting, sculpture, and applied art.

490. Special Problems. Cr. 2 to 4 each time taken.
Prerequisite: Permission of Instructor. Investigation of an
approved topic commensurate with student's interest and
ability.
H. Honors.

*Courses 125, 126, and 127 are offered for undergraduate
students in all curricula of the University.

Undergraduate Study

Opportunities for broadly based studies in the
sciences and humanities are provided by programs in
distributed studies. Ordinarily 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, human
medicine, law, and specialized technologies. Prepro-
fessional 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 either the Bachelor of
Arts or the Bachelor of Science degree. Programs
leading to either degree are flexible and will vary
in accordance with the educational objectives of
the student. (See Preprofessional Programs.) Programs in
distributed studies are also appropriate as pre-
paration for teaching in secondary schools (see College
of Education), and as preparation for graduate studies
in certain interdisciplinary areas.

A student wishing to develop a program in distrib-
uted studies should have educational or professional
goals which can best be met by a broader pro-
gram of study. A statement of these goals must
be approved by the dean's office before proceeding
to implement a program.

The student selects three fields related to his
educational goals and develops concentrations of study
in these fields which meet the following requirements:
He must earn 20 to 30 credits in each field, with
a total of at least 70 credits. All courses included
must be numbered 200 or above, and at least two-
thirds of the total credits must be in courses num-
bered 300 or above. Students in distributed studies
must meet all stated requirements for departmental
majors in each area of concentration except total
credits and specified courses in the major depart-
ment. The other degree requirements are those pre-
scribed for the curriculum in sciences and humanities
(see, Index).

Courses Primarily for Undergraduate Students

101, 102, 103. Studies in Sciences and Humanities.*
Cr. 1 to 5 each time taken. Yr. Prerequisite: Permission of
instructor. Experimental or honors courses offered by
any department or interdepartmental group.

201, 202, 203. Introduction to Latin America. (3-0)
Cr. 3 each. Yr. Prerequisite: 202: 201; 203: 201 or 202.
201: Continent, peoples, and cultures. 202: History and
cultural heritage. 203: Contemporary social, economic, and
political problems.

204, 205, 206. Introduction to Africa. (3-0) Cr. 3 each.
Yr. Prerequisite: 206: 204 or 205. 204: Continent, peoples,
and cultures. 206: History and cultural heritage. 206:
Contemporary social, economic, and political problems.

207, 208, 209. Introduction to East Asia. (3-0) Cr.
3 each. Yr. Prerequisite: 208: 206 or 209. 208: Continent,
peoples, and cultures. 208: History and cultural
heritage. 209: Contemporary social, economic, and political
problems.

Distributed Studies

Wallace A. Russell, Dean of the College of Sciences
and Humanities; Charles C. Bowen, Assistant Dean;
Millard R. Kratochvil, Assistant Dean; Alston J.
Shakeshaft, Assistant to Dean; Richard Zbaracki,
Chairman, Teacher Education Committee, College
of Sciences and Humanities

Professors: Harding, Kratochvil, Schneider.

Associate Professors: Kidd, Olorunsola, Zbaracki.

Assistant Professors: Bennett, Chatfield, DeLuca,
Dissinger, Keller, Myers, Rudolph, Stark, Young-
berg

Instructors: Anderson, Buckels, Dixon, Hadley, Schmidt.
301, 302, 303. Studies in Sciences and Humanities.* Cr. 1 to 5 each time taken. Yr. Prerequisite: Junior standing and permission of instructor. Experimental or honors courses offered by any department or interdepartmental group.

417. Student Teaching. Cr. 2 to 12 each time taken. F,W,S. Prerequisite: Educ 305; Engl 494 or Sp 495 or Math 497 or D St 480 or 496 or FLM 497 or FL L 476, or JI 480, or Music 466; 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—Secondary.
L. Music—Elementary.
M. Psychology.

460. Special Preparation in Subject Matter for Elementary and Secondary Teachers. Cr. var. Maximum of 12 credits in each area listed below:

A. Social Studies.
B. Physical Sciences.
C. Mathematics.
D. Biological Sciences.
E. English and Literature.
F. Physical Education for Men.
G. Foreign Languages.
H. Speech.
I. Journalism.
J. Earth Science.
K. Music.

486. Methods of Teaching Science. (3-0) Cr. 3. W. Prerequisite: Admission to teacher education, 15 credits in subject-matter field. Field trips.

490. Special Problems.* Cr. 1 to 5 each time taken. Prerequisite: Junior standing and permission of instructor.

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.

*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.

Undergraduate Study

The department offers courses in geography, geology, and meteorology. In addition, a specialized program in climatology is offered in the Department of Agronomy.

The department offers majors in earth science, geology, and meteorology leading to either a Bachelor of Science or Bachelor of Arts degree. Candidates for either the Bachelor of Science or the Bachelor of Arts degree must satisfy the requirements established by the College of Sciences and Humanities (see Sciences and Humanities Curriculum) and the departmental requirements for a major. Students desiring a Bachelor of Arts degree must complete a minimum of 35 credits of course work in the earth sciences. Students desiring a Bachelor of Science degree complete one of the programs listed below. Students planning to pursue a professional career or graduate study in one of the earth sciences should consider the Bachelor of Science program. A one-year sequence in one foreign language is strongly recommended in all programs.

The following programs are recommended to students desiring the Bachelor of Science degree:

Students majoring in earth science will take a minimum of 35 hours in the department, 15 hours at the 300 level and above. Course work must be taken in all three disciplines (geography, geology, and meteorology) offered by the department. Students wishing to obtain a teaching certificate must satisfy the requirement of the College of Education (see College of Education).

Students majoring in geology generally complete the following courses: Geol 100, 204, 271, 302, 351, 361, 371, 372, 381, 382, 431, 440, and 492. Supporting work is recommended in the mathematical and natural sciences.

Students specializing in geophysics commonly take the following courses: Geol 271, 302, 340, 351, 371, 372, 381, 382, 431, 440, and 492. Supporting work is recommended in computer science, mathematics, or physics.

Students majoring in meteorology normally take the following courses: Meteor 206, 208, 301, 302, 341, 342, 406, 421, 443, 444, 454, 455, 456. For students anticipating graduate study, minor work is recommended in a mathematical or physical science. Other students will find a wide range of supporting courses that will meet their specific interests in meteorology. The meteorology program is closely related to the climatology program. For further information concerning climatology, see Agronomy.

Graduate Study

The department offers work for the degree Master of Science and Doctor of Philosophy with majors in earth science, geology, and meteorology, and minor work to students majoring in other departments. A nonthesis option is offered for the degree Master of Science in earth science, and in meteorology.

Earth Science

Keith M. Hussey, Head of Department

Professors: Biggs, Lemish, Roy, Seifert, Sendlein, Vondra.

Associate Professors: Cody, Palmquist, Rahman, Yarger.

Assistant Professors: DeLuca, Frederic, Takle, Vaughan.

Instructors: Bowen, Clark, Zaring.
Geology majors interested in a broader program may obtain the degree Doctor of Philosophy with a major divided between geology and a related field. The department also cooperates in an interdepartmental program in water resources. See Water Resources.

Students desiring to major in earth science, geology, meteorology, or water resources normally have a strong undergraduate background in the physical and mathematical sciences. The background of each individual will be evaluated in light of expressed goals and the major.

The department requires no foreign language proficiency for the M.S. degree. Candidates for the Ph.D. degree are required to submit proof of reading knowledge of two foreign languages, or reading and speaking knowledge of one. The candidate's graduate committee may accept, as proof of mastery, either course grades in language courses taken at Iowa State University or examination scores of comprehensive examinations.

Course programs are arranged on an individual basis. Minor work is normally recommended in chemistry, computer science, engineering mechanics, mathematics, metallurgy, physics, soils, soils engineering, or zoology.

The following courses are open to graduate students for minor graduate credit only: Geog 421, 490; Geol 302A, 340, 351, 361, 371, 372, 381, 382, 401, 407, 411, 431, 440, 452, 492; Mtgeor 341, 342, 406, 421, 443, 444, 454, 455, and 456.

Courses Primarily for Undergraduate Students

Geography

201. World Geography. (3-0) Cr. 3. F.W. Character and distribution of the elements comprising man's physical environment; inter-relationships of the man-environment system.

202. Physical Geography. (3-2) Cr. 5. S. Physical characteristics of the earth's surface; their integrated patterns of world distribution and importance to man. Field trips.


204. Economic Geography. (3-0) Cr. 3. Alt. W., offered 1975. Character and distribution of natural resources; their influence on man and their utilization by man.

205. Cultural Geography—European and American. (3-0) Cr. 3. S. Climatic and physical geography of Europe and North, Central, and South America, and their influence on the cultural development of man in those areas.

206. Cultural Geography—African, Asian, Australian, and Pacific Islands. (3-0) Cr. 3. S. Climatic and physical geography of Africa, Asia, Australia, and the Pacific islands; their influence on the cultural development of man in those areas.

207. Geography of Anglo-America. (3-0) Cr. 3. Alt. S., offered 1975. Zaring. Analysis of the physical and cultural features that characterize and differentiate the geographical landscapes and regions.


209. Settlement Geography. (3-0) Cr. 3. Alt. W., offered 1974. Prerequisite: 201. Evolution, morphology, and spatial distribution of urban and rural settlement with an emphasis on North America and Europe.

Courses Primarily for Undergraduate Students

Geology

100. Introduction to Geology. (3-3) Cr. 4. F.W.S.S. Important earth processes, materials, and their interaction; field trips.

101. Technical Lectures. (1-0) Cr. R; F. Introduction to various phases of earth science. Required of all beginning students majoring in the earth sciences.

200. Geographical Aspects of Environment. (3-3) Cr. 4. F. Prerequisite: 100. Physical processes and forms and their relationship to man. Discussion of surface and near-surface geologic processes, and mineral occurrence; their use and misuse by man.

201. History of the Earth. (3-3) Cr. 4. W. Prerequisite: 100. Significant events in the geologic history and development of life upon the earth.

203. Geology Field Trip. Cr. 1 each time taken. W. Prerequisite: 100. Permission of instructor. Geology of selected regions studied by correlated readings and report presentation followed by a field trip to points of geologic interest. One week field trip required.

204. Map Interpretation. (0-3) Cr. 1. S.S. Prerequisite: 100. Analysis of topographic and geologic maps.

205. Physiography of the United States. (3-0) Cr. 3. S. Prerequisite: 100. Description and interpretation of the physical features in the natural regions of the United States, and man's adaptations to the physical environment.

271. Earth Materials. (2-6) Cr. 4. S. Prerequisite: 100. Field and laboratory identification, classification, description, and interpretation of rocks, fossils, and common rock-forming minerals.

301. Geology for Engineers. (2-3) Cr. 3. S. Sendlein. Fundamentals of geology and engineering applications; field trips.

302A, 302B. Summer Field Work. Cr. 8 to 12. SS. Prerequisite: 302A: 204, 271. Vondra; 302B: 100. DeLuca; 302B: Areal mapping; structural, stratigraphic, and geomorphic analyses. Written reports with appropriate illustration required. An 8-week summer field course required of all geology majors. 302B: Emphasis on geologic processes and products; secondary attention to related ideas in meteorology, astronomy, soils, and biology. An 8-week summer field course required of all non-geology earth science majors.

303. Undergraduate Seminar. Cr. 1. F.W.S. Prerequisite: 302A.

340. Introduction to Geophysics. (3-0 or 6) Cr. 3 or 5. S. Prerequisite: 302A, Phys 113 or 223. Sendlein. Application of physical principles to the determination of surface rock structure and/or boundaries. Includes seismology, gravmetry, magnetometry, and the techniques of electrical and radioactivity surveying. Field application of geophysical methods to include data acquisition, and computer processing and interpretation.

351. Mineralogy. (3-6) Cr. 6. F. Prerequisite: Chem 142. Biggs. Geochemistry of silicates and other rock-forming minerals; determinative mineralogy; elementary optical crystallography.

361. Invertebrate Palaoontology. (2-6) Cr. 4. S. Prerequisite: 100. Cody. Characteristics and relationships of invertebrates of fossil record; their use in historical geology. Field trips.

381. Structural Geology. (3-0) Cr. 3. W. Prerequisite: 271. Lemlsh. Theory of rock deformation. Description and classification of structures in the earth's crust. 382. Structural Geology Laboratory. (0-6) Cr. 2. W. Prerequisite: 271. Lemlsh. Application of descriptive geometry and map interpretation techniques to solution of structural problems.

400. Advanced Field Geology. Cr. 8 to 12. SS. Prerequisite: 371, 381. Vondra. An eight-week field course for the advanced geology major, emphasizing advanced field techniques and providing the student with experience in analyzing geologic field problems.


431. Geomorphology. (2-3 or 3-6) Cr. 3 or 5. F. Prerequisite: 100. Stat 101. Palquist. Interrelationship between geomorphic processes and earth materials in development of landforms; use of landforms in interpreting recent geologic history. Saturday field trips.

440. Petrophysics. (2-6) Cr. 4. W. Prerequisite: 302A, 371, 381, Math 211, Physics 223, Sendlein. Physical properties of rocks, including porosity, permeability, elastic properties, and heat and electrical conductivity. Rocks studied through laboratory investigations to establish their relationship to natural geologic materials and processes.


490. Special Problems. Cr. 2 to 4 each time taken. Prerequisite: 100, permission of instructor. H. Honors Program.

492. Stratigraphy. (3-3) Cr. 4. F. Prerequisite: 361, 371, 381. Vondra. Principles of stratigraphy and their application to and exemplification by geologic occurrences.

Courses Primarily for Graduate Students, major or minor, open to qualified undergraduates

Geology

501. Seminar. Cr. 1 each time taken. F.W.S. Prerequisite: Permission of instructor.


515. Geochemistry. (3-0) Cr. 3. Alt. F.; offered 1973. Prerequisite: Chem 211, 301, permission of instructor. Lemlsh. Emphasis on chemistry of geological processes related to changes in earth materials.

516. Laboratory in Geochemistry. (0-6) Cr. 2. Alt. F., offered 1973. Prerequisite: Chem 211, 301. Credit will not be given for both classiﬁcation in Geol 515. Lemlsh. Methods of sampling, analyzing, and interpreting chemical data obtained from geological materials. Field trips. Primarily for geology majors.


599. Special Topics. Cr. 1 to 3 each time taken.

A. Geomorphology.
B. Stratigraphy.
C. Paleontology.
D. Petrology and Mineralogy.
E. Structural Geology.
F. Geochemistry.
G. Water Resources.
H. Earth Science.
I. Sedimentation.
J. Economic Geology.
K. Rock Deformation.
L. Geophysics.
Courses Primarily for Undergraduate Students

Meteorology


205. Techniques of Weather Observation. (2-0) Cr. 2. W. Prerequisite: 206. Determination of weather variables through observation using standard meteorological instruments. Contact hour varies with credit hour.

301. General Meteorology I, II. (3-2) Cr. 4 each. Prerequisite: 301: 206, Math 120 or 123; 302: 301. Basic physical concepts which influence our earth and its atmosphere. Concepts of weathermap analysis.

311. Aviation Meteorology. (2-0) Cr. 2. F. Vaughan. Application of meteorology to aviation.

341. Atmospheric Thermodynamics and Statics. (4-0) Cr. 4. W. Prerequisite: Math 122 or 123; credit or classification in Phys 202. Yarger. Thermodynamics of the atmosphere; heat, mass, and momentum; eddy diffusion; statistical theories of turbulence; wind and temperature profiles near the surface; evaporation.

342. Physical Meteorology. (4-0) Cr. 4. S. Prerequisite: 341. Yarger. Basic radiation laws, clouds, physics, atmospheric electricity.


421. Meteorological Instruments. (2-3) Cr. 3. W. Vaughan. Prerequisite: Three credits of meteorology, Math 122 or 123; Phys 112 or 223. Theory and techniques of classical and modern meteorological instruments. Limitations of specific instruments and systems encountered in field and laboratory measurements. Emphasis on theory and calibration of instruments.

443, 444. Atmospheric Dynamics I, II. (4-0) Cr. 4 each. Prerequisite: 443: 341; 444: 443. Yarger. Equation of motion on a rotating earth, horizontal motion, kinematics of fluid flow, circulation, vorticity, divergence, equation of continuity, the general circulation.

455. Synoptic Meteorology I, II, III. (2-4) Cr. 4 each. Prerequisite: 454: 502 and credit or classification in 443: 455; 456: 455; 466. Brown. Case studies illustrating the structure and evaluation of air masses and frontal systems; three-dimensional analyses of large-scale weather systems; interpretation of centrally prepared weather charts, current weather discussion.

480. Special Problems. Cr. var. Prerequisite: Permission of instructor.

Courses Primarily for Graduate Students, major or minor

Geology


696. Research.

Courses for Graduate Students, major or minor

Meteorology


542. Physical Meteorology. (5-0) Cr. 5. F. Prerequisite: Phys 223, Math 213. Yarger. Wave phenomena, propagation of energy through the atmosphere, atmospheric optics, visibility, aerosols, radar, and meteorology.

543, 544. Dynamic Meteorology I, II. (4-0) Cr. 4 each. Prerequisite: 543: W; 544: S. Prerequisite: 543: 443; 544: 543. Fundamental equations, atmospheric waves, scale analysis, energy relations, barotropic and baroclinic models, numerical methods, atmospheric models of micro, meso, synoptic, and global weather phenomena.


590. Special Topics. Cr. var. Prerequisite: Permission of instructor.

Courses for Graduate Students, major or minor

Meteorology

605. Micrometeorology. (5-0) Cr. 5. Alt. F., offered 1974. Prerequisite: Permission of instructor. Physical processes in the atmosphere near the ground; turbulent flow; transfer of heat, mass, and momentum; eddy diffusion; statistical theories of turbulence; wind and temperature profiles near the surface; evaporation.


699. Research. Cr. var. Prerequisite: Permission of instructor.
Economics

Raymond R. Beneke, Acting Head of Department

Professors: Arthur, Ball, Baumel, Christian, Davey, Eldridge, Fletcher, Fox, Fuller, Futrell, Harl, Head, Holdren, Howell, Hoyt, James, Julius, Kaldor, Ladd, Liston, Luckett, Merrill, Meyer, Murray, Ogg, Paulsen, Robotka, Scott, Sengupta, Shepherd, Starleaf, James Stephenson, Stoneberg, Strain, Thomas, Torbecke, Timmons, Wallace, Wallace Wright.

Associate Professors: Cheng, Doak, Faden, Gratto, Maxon, Mayer, Skadberg, Van der Wetering.

Assistant Professors: Roy Adams, Bodensteiner, Harris, Hammond, Lapan, Pounds, Raikes, Wisner.

Visiting Assistant Professors: Andron, Elkin.


Undergraduate Study

The department offers work for the degree Bachelor of Science with major in agricultural business, and for the degrees Bachelor of Science and Bachelor of Arts with major in economics. For further discussion of programs in agricultural business, see the statement under College of Agriculture. For programs in economics, see the statement under College of Sciences and Humanities.

College of Agriculture

For the undergraduate curriculum in agricultural business, see College of Agriculture, Curriculum.

Students majoring in agricultural business must select one minor from economic analysis, farm management, marketing management, public policy, agricultural education, and agricultural communication. A second minor may be developed in related departmental areas. The curriculum prepares students for advanced studies and for careers in farm and ranch operations, commercial farm management and appraisal, agricultural finance, agricultural supply and marketing industries, research for business firms, agricultural reporting and public relations, agricultural extension, and government service.


College of Sciences and Humanities

Candidates for either the Bachelor of Science or the Bachelor of Arts degree with major in economics must fulfill certain requirements established by the College of Sciences and Humanities (for details of undergraduate curricula in sciences and humanities, see College of Sciences and Humanities, Curriculum).

In addition to the requirements of the College of Sciences and Humanities, the Department of Economics requires for the degree Bachelor of Science the inclusion of Engi 414 in the communications group. Within the mathematical and natural sciences group requirements, the economics major is required to take 21 credits of mathematical sciences, including either Math 120, or Math 130, or both Math 161 and 162. One course in statistics and one course in computer science, each at the appropriate level for economics majors, are also required. Within the social sciences group, the economics major is not allowed to use any economics courses to fulfill the minimum requirement. Besides these departmental requirements, 36 credits in economics are required for majors in economics, including Econ 241, 242, 301, and 409.

For the degree Bachelor of Arts, the Department of Economics requires that Engi 414 be included in the communications group. Within the mathematical and natural sciences group requirements, the economics major is required to take 15 credits including one course in statistics at the appropriate level for the student. Within the social sciences group, a minimum of 12 credits outside the discipline of economics is required. At least 18 credits are to be chosen from the arts and humanities group. Thirty-six credits in economics are required for majors in economics, including Econ 241, 242, 301, 312, and 409.

Graduate Study

The department offers work for the degrees Master of Science and Doctor of Philosophy with majors in agricultural economics, and minor work to students taking major work in other departments.

Candidates for the degree Master of Science are required to complete satisfactorily 45 credits of acceptable graduate work, including preparation of a thesis. With the approval of the program of study committee, candidates for the degree Master of Science may fulfill requirements by satisfactorily completing 54 credits of course work, in which case preparation of a thesis is not required.

Prerequisite to major work in the department is the completion of undergraduate work in economics, mathematics, statistics, and other social science and technical subjects substantially equivalent to that required of undergraduate students majoring in economics or agricultural business.

For the Bachelor of Science degree, completion of 12 credits of course work in foreign language is required for the degree Master of Science.

Programs of study for the doctorate are organized by each student in consultation with his major
Courses Primarily for Undergraduate Students

*110. Orientation in Agricultural Business. (1-0) Cr. R; F. Field of agricultural business.

*130. Elements of Farm Management. (3-2) Cr. 4. F.W.S. Restricted to freshman or sophomore classification. Application of economic principles to organization and management of a farm. Budgeting, size of business, choices of enterprise; timing of production, farm labor utilization, farm layout; leases and farm credit. The department recommends that credit in both 130 and 330 not be applied toward graduation.

*190. Supervised Practice. Cr. 1 to 12. F.S.S. Prerequisite: Nine credits in economics. Twelve to 24 weeks of full-time observation and supervised experience in the employ of selected agricultural businesses. Not more than six credits will apply toward a B.S. degree.

*192. Agri-Business Operations. (4-2) Cr. 5. F.S. Survey of firms servicing agriculture, application of accounting and business management principles to operation of farm, marketing, and agricultural supply firms. Planning, organizing, directing, coordinating, and control function of management. Use of plant records, forms, and statements; financial; merchandising; personnel administration; production plans. Visits to representative businesses.

*230. Farm Accounting and Business Analysis. (2-2) Cr. 3. F.W.S. Purpose and methods of keeping farm records and procedures in accounting; income and net worth statements; use of efficiency factors; analysis of the farm business; and the use of accounts for tax purposes.

241, 242. Principles of Economics. (3-0) Cr. 3 each. F.W.S.S. 241: Problems of resource allocation; demand and supply; national income, employment, and price levels; fiscal and monetary policy; operation of the banking system; elements of international finance. 242: Theories of production and consumption; pricing and the market system; perfect and imperfect competition; business and labor regulation; elements of international trade.

300. Contemporary Economic Problems. (3-0) Cr. 3. F.W.S. Prerequisite: 241, 242. Survey of major economic issues confronting our society today. Topics include nature of modern American capitalism, military expenditures, housing, education, transportation, the farm, environment, poverty.

301. Prices and Resource Allocation. (5-0) Cr. 5. F.W.S. SSI. Prerequisite: 242. Theory of consumption and of the business firm; competitive and monopolistic markets; distribution of income; general equilibrium of the pricing system.

304. Money and Banking. (5-0) Cr. 5. F.W.S. SSI. Prerequisite: 241. History and theory of banking; market structure of banking; bank management; money and capital markets; nonbank financial institutions; central banking; monetary theory; international monetary arrangements; monetary policy.


308. Comparative Economic Systems. (3-0) Cr. 3. F.W.S. Prerequisite: 242. Comparison of alternative forms of economic organization, particularly capitalism, liberal socialism, and central planning; emphasis on selected problems associated with respective economic systems; prospects for institutional change.

312. History of Economic Thought. (3-0) Cr. 3. S. Prerequisite: 242. History of economic thought as related to the intellectual history of the times. Major persons treated include Smith, Ricardo, Marx, Marshall, and Keynes.

*330. Farm Management and Organization. (3-2) Cr. 4. F.S.SSI. Prerequisite: 242; 230 or I Ad 384 recommended. Organization and management of a farm with emphasis on use of economic principles. Enterprise selection, size of business, budgeting, leases, layout, and farm analysis. The department recommends that credit in both 130 and 330 not be applied toward graduation.

*385. Introduction to Agricultural Marketing. (3-2) Cr. 4. F.W.S.SSI. Prerequisite: 242. Composition of the agricultural marketing complex; functions performed by the complex; price-making forces for agricultural products; use of market information in forecasting commodity prices; factors affecting marketing environment; futures markets, speculation, and hedging; alternative marketing methods for major Iowa agricultural commodities.

*387. Organization and Performance of Agricultural Markets. (2-0) Cr. 2. S. Prerequisite: 335; classification in 338A or 338B. Examination of livestock, grain, dairy, and selected other agricultural industries; market structures, price and nonprice policies, government regulation; emphasis on development of analytical framework, and comparison of organization and performance of agricultural industries.

*338A, *338B. Agricultural Marketing Laboratory. (0-2) Cr. 1 each. S. Prerequisite: 335; classification in 337. 338A: Examination of livestock and meat industries; trends in demand for various livestock and meat products; in-
Industrial organization and performance; pricing and grading systems; competitive position of Iowa and the U.S. livestock and meat industries; government regulations; promotional efforts. 338B: Examination of the grain, grain processing, and oil seed industries; trends in demand for grain and grain products; industry organization and performance; pricing and grading systems; competitive position of Iowa and the U.S.; government regulation and promotional efforts.

*380. Economics of Natural Resource Use. (3-2) Cr. 4. F. Prerequisite: 242. Natural resource availability, use and control; environmental implications; resource conservation; investment, and taxation. Primarily for undergraduates students not majoring in economics or agricultural business. The department recommends that credit in both 380 and 480 not be applied toward graduation.

405. Public Finance. (3-0) Cr. 3. F.W.S. Prerequisite: 242. Principles of taxation; federal, state, and local revenue and expenditure policies; current issues in public finance.


411. Economic Development. (3-0) Cr. 3. F. Prerequisite: 242. Analysis of capital formation and capital allocation problems; relation of transportation, communications, and resource availability to development; population and education problems as they relate to growth.

*412. Economics of Agricultural Development. (3-0) Cr. 3. W. Prerequisite: 242; 330 or 436. Less-developed economies; share and role of agriculture in labor force and national income; structure of agriculture; subsistence and commercial sectors; population, food, and nutrition; institutional considerations; policies for development; aid and international trade.

*421. Cooperatives. (3-0) Cr. 3. W. Prerequisite: 242. General survey of cooperative activities, with special reference to agriculture; kinds of cooperatives, methods of organization and operation; principles, legal requirements, economic possibilities and limitations of cooperation.

*430. Advanced Farm Organization and Management. (2-2) Cr. 3. F.W.S. Prerequisite: 242; 130 or 330. Applications of budgeting and linear programming to planning organizations for varying soil, market, capital, tenure, and farm-size situations.

*432. Management of Tenant-Operated Farms. (2-0) Cr. 2. W. Prerequisite: Senior classification; 130 or 330. Business and management principles, economic rules to the operation of rented farms; working relationships with farm tenants. Two all-day field trips.

*435. Agricultural Finance. (3-0) Cr. 3. W. Prerequisite: 242. Financial requirements of individual farmers and principles applicable to borrowing by farms and farm cooperative organizations. Analysis of lending agencies including commercial banks, insurance companies, merchants and dealers, Farm Credit Banks, and Farmers Home Administration.

*436. Agricultural Marketing Analysis. (2-2) Cr. 3. W. Prerequisite: 301, Stat 101; Stat 327 recommended. Introduction to use of economic theory and quantitative techniques in analysis of agricultural marketing problems; construction of economic models, statistical estimation of supply and demand, price forecasting, analyses of inter-regional and intertemporal price differences.

*440. Appraisal of Farm Real Estate. (2-3) Cr. 3. S. Prerequisite: 242, Agron 154. Land appraisal with emphasis on valuation procedure, relationship of farm prices, taxes, and interest rates to value. Appraisal reports.

444. Management: Theory and Practice. (3-0) Cr. 3. F.W.S. Prerequisite: 301. Analytical approach to business management. Business decision making with aid of quantitative methods such as linear programming, statistical decision theory, inventory theory, and other tools of operations research.


*447. Agricultural and Rural Policy. (3-0) Cr. 3. F.W.S. Alt. SSI. Prerequisite: 242. Description and analysis of government actions to develop agriculture and improve the quality of the rural environment; i.e., raise resource earnings, reduce pollution, alleviate poverty, and reduce instability.

*451. Agricultural Law. (3-2) Cr. 4. F.W.S. Prerequisite: Senior classification. The legal framework imposing upon decision making by farm firms, families, and individuals: liabilities, real and personal property, contracts, uniform commercial code, organization of farm firms, inter-generational property transfers, water law, fence law, federal and state regulatory powers, insurance, and taxation.


461, 462. Urban-Regional Economics. (3-0) Cr. 3 each. 461: S.; 462: F. Prerequisite: 242, 461: Regional growth and efficiency, locational determinants of firms and households; the regional economic base, resource development, and economic planning in the city-region. 462: Theories of urban development, city typologies, trade and commuting patterns, urban economic interdependence, social investments in metropolitan communities.

465. Economics of Educational Systems. (3-0) Cr. 3. SSI. Prerequisite: 242. Economic problems of public education, such as resources within school systems; economic analysis of resources available to schools and school systems; economic aspects of human resource development pertinent to education; interrelationships among an area's school system, its population, and its resource base.

466. Retailing. (3-0) Cr. 3. S. Prerequisite: 242. Economic nature of retailing; retail market structure; store organization; merchandising and pricing policies; retail control.

*470. Economic Aspects of Rural Community Development. (3-0) Cr. 3. W. Prerequisite: 242. Economic analysis of changing conditions in rural communities. Role of the rural town in development of rural areas. Impact of modernizing agriculture on rural towns. Impact of scale efficiencies in merchandising and transportation systems. Role of the alternate goods and services for industrialization, adjustments in economic structure and institutions to improve incomes, public services, the rural community environment.

*480. Natural Resource Economics. (3-0) Cr. 3. W. Prerequisite: 301. Theories of resource allocation and income distribution; externalities, public goods, and environmental quality; planning for natural resource use; methodology for analyzing resource problems. The department recom-
Courses Primarily for Graduate Students, major or minor, open to qualified undergraduates

501, 502 Intermediate Microeconomic Analysis. (3-0) Cr. 3 each. 501: F.W.SSI; 502: W.S.SSI. Prerequisite: 301. Fletcher, Merrill, Staff. Economic theory and methodology; theory of consumer behavior and demand; production functions, costs, and firm behavior; equilibrium of consumers, firms, and industries; general equilibrium, economic efficiency, and welfare; behavior of firms in non-perfect competition and optimality of resource allocation; functional income distribution and the behavior of income shares.

503. Intermediate Macroeconomic Analysis. (3-0) Cr. 3. F.S.SSI. Prerequisite: 408. Starleaf, Staff. 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, neoclassical, Keynesian, and neo-Keynesian models.


512. Agrarian Reform and Economic Development. (3-0) Cr. 3. S. Prerequisite: 301 or 480. Townsend. Meaning of economic development, underdevelopment, overpopulation, agrarian structures as obstacles to economic development. Improving agrarian structures through national, regional, and United Nations action. Comparative structural change in countries.

515. Industrial Structures and Competition. (3-0) Cr. 3. F. Prerequisite: 502. Fletcher, Harl, Merrill. Business concentration in the American economy; structures and competitive practices of particular industries; mergers, vertical and horizontal integration; measurement and evaluation of competition and monopoly; economic problems of public control of competition.

516. Economic Aspects of Antitrust and Trade Regulation. (3-0) Cr. 3. W. Prerequisite: 515. Harl. Analysis of the legal manifestations of national economic antitrust and trade regulation policy; rationale for public intervention in industrial organization and price output policy; exemptions from antitrust law; price control; market divisions and agreements not to compete; refusal to deal; monopoly; merger; resale price maintenance; discrimination in distribution; unfair trade practices; remedies under antitrust law; effectiveness of antitrust policy.

531. Agricultural Market Organization and Business Behavior. (3-0) Cr. 3. F. Prerequisite: 501. Fletcher, Ralkes. 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 Economic Research. (3-0) Cr. 3. W. Prerequisite: 501, credit or classification in Stat 402. Ladd. Examination of models and theories from economics and other social sciences relevant to marketing and forecasting problems; use of these models and theories for hypothesis formulation; selection and use of quantitative techniques.

533. Research Design in Agricultural Marketing. (3-0) Cr. 3. S. Prerequisite: 501. Doak, Scott. Current problems in agricultural markets and marketing; integration of theory, models, techniques and data in problem formulation; role of information in decision processes; research objectives, organization and financing—state, federal and industry; dissemination and application of research findings.

534. Economic Development and Transformation of Agriculture. (3-0) Cr. 3. Alt. S., offered 1974. Prerequisite: 501. Heady. Growth of economic growth to factor prices and the technological and firm structure; firm behavior and aggregate response in product supply and factor demand; developmental needs for transformation of agriculture and resource mobility; supply and resource problems under different stages of development; policy needs for alternative problems in development.

535. Dynamic Macroeconomic Analysis. (3-0) Cr. 3. Alt. S., offered 1975. Fundamentals of dynamic economic theory; equilibrium and disequilibrium systems; stability of equilibrium in linear and nonlinear systems.

537. Linear Economic Models. (3-0) Cr. 3. F. Prerequisite: 301, Math 104. Ladd. Selected applications of mathematics to economic problems; includes game theory, linear programming, and input-output analysis.


541. Agriculture in the World Economy. (3-0) Cr. 3. S. Prerequisite: 242. Paulsen. The varied economic role of agriculture around the world and during economic development, regional and commodity trade patterns and trends, trade regulation mechanisms, trade policies, and agricultural development assistance.


545. Economics of Taxation. (3-0) Cr. 3. W. Prerequisite: 501. Meyer. Taxation, shifting and incidence, public debt, fiscal federalism.

548. Quantitative Agricultural Price Analysis. (3-0) Cr. 3. S. Prerequisite: Stat 402; credit or classification in 502. Ladd, Ralkes. Methods of economic and statistical analysis of agricultural prices, costs, supply, demand, consumer behavior, and firm behavior. Applications of economic and statistical methods to private and public decision making.

551. Monetary Theory. (3-0) Cr. 3. F. Prerequisite: 503. Christian, Luckett. The monetary mechanism: Neoquantity theory, neo-Keynesian monetary theory and the portfolio approach, microeconomic aspects of monetary theory, including monetary determinants of cost of capital. Rate of interest, expectations and lag in effect of monetary policy. Money supply theory.

552. Advanced Money and Banking. (3-0) Cr. 3. W. Prerequisite: 503. Christian, Luckett. Advanced topics in...
monetary economics, including monopoly and competition in banking, models of commercial bank behavior, term structure of interest rates, instruments of monetary control, debt management, effectiveness of monetary policy.

555. Advanced International Economics. (3-0) Cr. 3. W. Prerequisite: 301. Cheng, Thorbecke. Modern theory of international pricing and allocation; foreign trade multiplier and international monetary equilibrium; problems of international economic stability; multilateral trade and economic development.

556. Regional Economics. (3-0) Cr. 3. Alt. W. Prerequisite: 502. Theories of regional growth and development; interregional input-output, programming, and econometric models; population, migration, and methods of analyzing spatial interaction; regional delineation and policy.

557. Advanced International Finance. (3-0) Cr. 3. S. Prerequisite: 409; 503 and 555 recommended. Cheng. Theory of foreign exchange, mechanism of adjustments in the balance of payments, exchange speculation and the forward exchange market, selected topics in international monetary policy.

*561. Agricultural Resource and Income Problems. (3-0) Cr. 3. F. Prerequisite: 301. Kaldor. Analysis of adjustment, instability, and income distribution between sectors; forces of agricultural disequilibrium, adaptability of the farm industry; sources of short-run price and income instability; farm family income problems related to structural imbalance and inadequate resources.

*562. Agricultural Resource and Income Policies and Programs. (3-0) Cr. 3. W. Prerequisite: 561. Bahl, Kaldor. Description, analysis, and evaluation of public policies and programs influencing agricultural resource investment; allocation, organization, and distribution of income within agriculture and between agricultural and nonagricultural sectors.


568. Urban Economics. (3-0) Cr. 3. Alt. S. Prerequisite: 501. Faden. History of world urban development; economic foundations of the city, agglomerating forces, linkage; theories of city growth and theory of urban hierarchy; growth of cities; urban hierarchies; core-suburban relations and size distribution; commuting patterns, land-use patterns, CBD functions; metropolitan problems, transportation, housing, congestion, and neighborhood effects.


573, 574. Applied Econometric Models. (3-0) Cr. 3 each. 573: W; 574: S. Prerequisite: 573: 538; 574: 573. Stephenson, Staff. Selected applications of econometric techniques to models of consumer demand behavior, models of cost and production, investment, the financial sector, the agricultural sector, and macroeconometric models.

578. Regional Economic Planning. (3-0) Cr. 3. Alt. S. Prerequisite: 301. Van de Wetering. Regional economic aspects of resource management; role of economic information in physical planning. Problems of public policy for control and use of natural and human resources in regional development. Applications of systems analysis to public planning in river basins and metropolitan regions.

590. Special Topics. Cr. 1 to 5 each time taken.


595. Law of Labor Relations. (3-0) Cr. 3. W. Prerequisite: 305. Davey. Federal and state legislation affecting the collective bargaining process, including analysis of selected court decisions. Role of government in adjustment of labor disputes. Legal aspects of labor arbitration.

596. Wage Theory and Collective Bargaining. (3-0) Cr. 3. Alt. S. Prerequisite: 502. Davey. Theoretical and empirical analysis of market and institutional forces determining wage rates, wage levels and wage differentials, especially in unionized labor markets.

Courses for Graduate Students, major or minor

601, 602, 603. Advanced Economic Theory. (3-0) Cr. 3 each. Yr. Prerequisite: 601: 503; 602: 501; 603: 602. Starleaf, Stephenson, Staff. 601: Capital theory: productivity of capital, intertemporal resource allocation and investment criterion; production functions and technical change; theories of investment; theory of capital accumulation; dynamic capital theory. 602: Advanced approach to the general equilibrium theory. Linear programming model of general equilibrium. Welfare economics: Pareto optimality and various compensation principles; social welfare function. 603: General equilibrium foundations of modern macroeconomic theory; post-Keynesian development of the consumption function; theory of investment; money and economic activity; dynamic macroeconomic models; theories of inflation.

605, 606. History of Economic Thought. (3-0) Cr. 3 each. 605: F.; 606: S. Prerequisite: 502, 503. Luckett. Principal figures in the development of economic ideas; contribution of each period of economic thought. 605: The Mercantilists to the Classical School, inclusive. 606: Critic of the Classical School to J.M. Keynes.

614, 615. Advanced Theoretical Analysis. (3-0) Cr. 3 each. 614: F.; 615: W. Prerequisite: 614: 502, Math 204 or 307, and 408; 615: 614. Faden. Advanced treatment of topics, including human capital, innovation, production, trade formation, income distribution, unemployment, control, Introduction to advanced literature, including relevant models from other social sciences.

634. Land Valuation. (3-0) Cr. 3. S. Prerequisite: 301. Murray. Factors determining land value; fluctuation in land prices; critical evaluation of appraisal methods.

635. Farm Credit Theory. (3-0) Cr. 3. W. Prerequisite: 301. Murray. Farm credit policies and methods of extending credit. Organization and operation of lending agencies, private and governmental. Evaluation of alternative agricultural credit systems.

*641. Economics of Agricultural Production. (3-0) Cr. 3. F. Prerequisite: 601. Heady. Production principles applied to use of land, labor, and capital; static and dynamic firm theory; farm size; resource and product combinations; production location; timing of production and conservation; cost structure; leases and asset control; uncertainty and expectations.

*642. Resource Efficiency and Allocation in Agriculture. (3-0) Cr. 3. S. Prerequisite: 641. Heady. Programming, systems, simulation, and other models for development; optimal land and water use, and spatial and intertemporal relationships; aggregative resource demand and commodity supply; private and public objective functions; structural transformation of agriculture and policy evaluation relative to problems of efficiency, equity, environment, and rural community economic opportunities.


*670. Resource Allocation in Forestry. (For 670) See Forestry.

672. Capital and Growth. (3-0) Cr. 3. Alt. S., offered 1974. Prerequisite: 570, 603. Sengupta. Theories of capital accumulation and multi-sector models of economic growth; optimum and efficient growth; applications to planning and resource allocation models; stochastic process applications.

*680, 681, 682. Natural Resource Economics. (3-0) Cr. 3 each. Yr. Prerequisite: 680: 460, 502; 681: 680; 682: 681. Harl, Timmons. 680: Nature, objectives and problems of natural resource use and environmental quality. Physical, economic, and institutional interrelationships. Economics of ecosystems and environmental quality. Characteristics, criteria, and classes of natural resources. Demand for and supply of natural resources by classes and individual resources. 681: Theory of inquiry applied to natural resource problems; decision making in managing natural resources and environmental quality; objective functions; costs and benefits; market and nonmarket considerations; intertemporal and interregional allocations; multiple purpose resource development. 682: Policy, planning, and programming for natural resource use and environmental quality; alternatives and options; time and space; local, state, regional, national, and international levels; current policies and programs with appraisal; legal constraints on resource use and environmental quality; private and public considerations.

690. Seminar. Cr. 1 to 3 each time taken. F.W.S. Prerequisite: Six credits of graduate work in chosen field. Current topics in economic theory and applied economics. Offerings each quarter will be selected from the following list:

A. Industrial Organization.
B. International Economics.
C. Economic Development and Policy.
D. Monetary Economics.
E. Public Finance.
F. Urban-Regional Economics.
G. Agricultural Marketing and Price Analysis.
H. Agricultural Development.
I. Labor Economics and Labor Relations.


*699. Research.

*A. Agricultural Economics.
B. Economics.

*Administered by the College of Agriculture. Courses not marked by an asterisk are administered by the College of Sciences and Humanities.

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**Education**

Ray J. Bryan, Professor in Charge, Professional Studies
Harold E. Dilts, Professor in Charge, Secondary Education

**Professors:** Bath, Boyles, Fred G. Brown, Bundy, Charles, Crawford, Gowan, Harding, Holmes, Howe, Hughes, Kohlmann, Kratochvil, Lagomarcino, Lawrence, Morgan, Schloerke, Schneider, Toman.


**Assistant Professors:** Atwell, Byler, Chatfield, Deluca, Dissinger, Ebbers, Glass, Goodale, Hart, Huyck, Jones, Kahler, Keith, Keller, Lohr, McMullen, Messenger, Blanche R. Miller, Phyllis G. Miller, Millsaps, Phemister, Phye, Ronald L. Redick, Rudolph, Rupnow, Francis Smith, Stark, R.A. Thomas, Wood, Youngberg, Zimmerman.

**Instructors:** Anderson, Boston, Buckels, Carter, Hadley, Irwin, Olsen, Muench, Sharon Redick, Simonson.

**Undergraduate Study**

Students seeking recommendations for a certificate to teach in the secondary schools must be admitted to the teacher education program and pursue a program which includes the following professional sequence courses: Educ 204, 305A, 305B, 426; Psych
Graduate Study

Professional studies offers work for the degrees Master of Science, Master of Education, and Doctor of Philosophy with major in education and minor work to students taking major work in other departments. Within the education major a student may specialize in adult education, guidance and counseling, and philosophy of education. Within the industrial education major, a student may specialize in vocational-technical education.

Prerequisite to major graduate work in education is preparation substantially equivalent to the completion of one of the undergraduate curricula in education offered at Iowa State University and adequate proof that the student ranks above average in scholastic ability and promise of professional competency.

There is no language requirement for the degree of Master of Science or Master of Education. A doctoral candidate must have met one of the following requirements: (1) demonstrated a satisfactory reading knowledge of two languages selected from French, German, Russian or Spanish, or (2) demonstrated a significantly higher level of competence in one of the named languages. A student who has completed two years of undergraduate study in one of the named languages with a B average will be considered to have met the requirement of (1) above for one language. At the discretion of the student's advisory committee, a student may substitute nine quarter credits of graduate work in addition to the minimum Ph.D. requirements in approved areas for one language or 18 credits for two languages in meeting the requirement under (1) above. These credits must be from departments other than professional studies. Students whose native language is not English may substitute competence in English.

Other graduate programs related to education (including General Graduate Studies) may be planned for students on the basis of previous education and experience as well as future plans and needs. Students should refer to Agricultural Education, Home Economics Education, Industrial Education, and General Graduate Studies or to graduate-level course offerings within other departments.

Open to graduate students for minor credit only: Educ. 426, 468.

Courses Primarily for Undergraduate Students

204. Foundations of American Education. (3-0) Cr. 3 F.W.S.S. 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.S.
B. (1-2) Cr. 1 F.W.S.S. Prerequisite: 204, classification in Psych 333, eligibility for and formal application submitted to the teacher education program; junior classification. A. Current educational methods and their subsequent utilization in the classroom. Special emphasis on planning, objective formulation, and teaching techniques. B. Instructional media.

333. Educational Psychology. (Psych 333) See Psychology.


428. Principles of Secondary Education. (3-0) Cr. 3, F.W.S.S. Prerequisite: 305 or equivalent. Problems of teacher relationships, pupil management and guidance, the curriculum, extra-curricular activities, trends in education, secondary school population, community school, evaluation of pupil progress, codes of professional ethics.

468. Extension Education. (3-0) Cr. 3 F. Prerequisite: Permission of instructor. History and philosophy of university extension education; objectives, organization, and procedures of university extension. Principles and procedures of instruction and evaluation in extension education.

476. Methods of Teaching Foreign Languages. (F L 476) See Foreign Languages.

486. Methods of Teaching Science. (D St 468) See Distributed Studies.

490. Special Problems. Cr. 1 to 5. Prerequisite: Junior classification, quality-point average of 2.5 or more for preceding two quarters.
A. Music Education. (Music 490A) See Music.
B. Vocational and Educational Guidance.
C. Curriculum Construction.
D. Principles of Education.
E. Methods of Teaching.
H. Honors Program.
I. Foundations of Educational Statistics.
S. Foundations of Education.


495. The Teaching of Speech. (Sp 495) See Speech.

496. Methods of Teaching Social Studies. (D St 496) See Distributed Studies.


497Z. Methods of Teaching Physical Education. (P E M 497Z) See Physical Education for Men.
CoursesPrimarilyforGraduateStudents, major or minor, open to qualified undergraduate.

501. Sources, Selection, and Preparation of Educational Media. (2-2) Cr. 3. F.S.SI. Prerequisite: 305B. Volker. Organization of educational media centers. Sources and selection of software and hardware. Analysis of current research in effectiveness of teaching and learning through media. Preparation of a variety of teaching materials.


517. Supervision of Student Teachers and Other Preprofessional Laboratory Experiences. (3-0) Cr. 3. S.SI. Prerequisite: Permission of Instructor. Schloerke. Designed for elementary and secondary school teachers. Emphasis is placed on the cooperating teacher's role relative to student teaching and teaching interns. Consideration is given to such topics as the orientation and guidance of future teachers, practical value of observation, cooperating teacher-student teacher planning, and continuous evaluation throughout the program.

520. Teaching Strategies and Elementary School Organization. (5-0) Cr. 5. F.S.SI. Prerequisite: El Ed 344, Psych 333. Holh. The role of the school organization in the development and the utilization of teaching strategies and the effect of various strategies on learning.

522. Principles of Corrective Reading. (3-0) Cr. 3. W.SSI. Prerequisite: 520. Merkley, Identification, symptoms, causes, assessment, and correction of reading problems within the elementary classroom instructional program.

530. Principles and Practices of Guidance. (3-0) Cr. 3. W.SS. Prerequisite: Fifteen credits in education and psychology, including Educ 426 and Psych 333. Bryan, Hopper, Pellegreno. Principles and practices in the guidance services; individual inventory, informational services, counseling, placement, follow-up, assisting school staff, and coordination of school, home, and community efforts.

531. Analysis of the Individual. (2 or 3-0) Cr. 2 or 3. F.W.SS. Prerequisite: 530, Psych 440. Canute, Hopper. Collection, organization, and interpretation of data pertinent to the study of pupils in relation to problems of educational and vocational planning and personal adjustment. Includes techniques for identifying the utilizing sources of information, and for collecting, analyzing, recording, and maintaining data about individual pupils.

532. Guidance Services in the Elementary School. (3-0) Cr. 3. F.S.SS. Prerequisite: 530. Pellegreno. Overview of current practices in guidance at the elementary school level; guidance services, roles of personnel involved, and the articulation of the elementary and secondary school guidance programs.

533A, 533B, 533C. Counseling Students. (3-0) Cr. 3 each. 533A: F.S.SS.; 533B: W.SS.; 533C: W.SS. Prerequisite: 530A: 530; 530B: 533A; 533C: 532, 533A. Hopper, McMillan, Miller, Pellegreno. 533A: Introduction to School Counseling. Consideration of major approaches to counseling secondary and elementary school students. 533B: Techniques of Counseling Secondary School Students. Interviewing with students, role playing, and observation of counseling. 533C: Techniques of Counseling Elementary School Students. Use of play media in counseling emphasized. Interviewing and observations for counseling.

534. Administration of the Guidance Services. (2 or 3-0) Cr. 2 or 3. S.SSI. Prerequisite: 530. Hopper, McMillan, Pellegreno. Administrative principles and practices in organizing and implementing the guidance services.

535. Group Procedures in Guidance. (3-0) Cr. 3. F.S.SSI. Prerequisite: Permission of instructor. Hopper, Miller, Pellegreno. Methods for organizing, maintaining, conducting, and evaluating group counseling sessions.

536. Adult Education. (1 or 2-3) Cr. 2 or 3. F. Prerequisite: Fifteen credits in education. Holmes. Philosophy and need for continuing education in a democratic society. Survey of current trends 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.SSI. Prerequisite: Fifteen credits in education. Holmes. Principles and practices in directing adult learning-experience activities. Techniques for leading adult groups in both formal and informal situations. Study and evaluation of various methods including creative techniques in group planning and decision making.

541. Introduction to Education Administration. (2 to 4-0) Cr. 2 to 4. F.S.SI. Prerequisite: 426, Psych 333. Engel. Philosophy and purposes of education in a democratic society. Basic principles of school administration. Analysis of the nature and function of units of education at local, intermediate, and state levels; principles and procedures for their reorganization.

542. The Community Program of Secondary Education. (2 or 3-0) Cr. 2 or 3. S.SSI. Prerequisite: 426. Ditto. The analysis and evaluation of secondary programs, including extra-class activities; education programs for post-high school youth and adults; local community resources as curriculum content; curriculum revision.

543. The Administration of School Personnel I. (2 or 3-0) Cr. 2 or 3. W.SSI. Prerequisite: Fifteen credits in education. Engel. Selection and organization of the teaching staff; personnel policies; stimulation of professional growth; management of nonprofessional employees. Nature of leadership.

544. Facilities in Higher Education. (2 or 3-0) Cr. 2 or 3. S.SSI. Prerequisite: 549. Hart. Educational specifications for community college including socioeconomic, transportation and traffic systems, and population centers in the geographic areas. The planning team. Curriculum, enrollment projections, and programming of required space needs.

545. The Community Program of Elementary Education. (2 to 4-0) Cr. 2 to 4. S.SSI. Prerequisite: Fifteen credits in education. Holh. 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 filling education; the fine arts; elementary school extra-class activities; community resources.

546. School Business Management. (3-0) Cr. 3. W.SSI. Prerequisite: 541. Engel, Hart, Manatt. Fiscal administration of local school systems; budgeting; financial accounting; auditing school accounts and other aspects of school business management, including insurance, transportation, buildings and grounds, and planning and construction.

547A, 547B. Supervision of Instruction. (3-0) Cr. 3 each. 547A: F.S.SS.; 547B: F.S.SI. Prerequisite: Fifteen credits in education. 547A: Hohl, 547B: Engel, Manatt. 547A: Improvement of individualized instruction in elementary and secondary schools. Evaluation of teaching effectiveness. Techniques of team teaching, individualized instruction, and continuous learning progress. 547B: Purposes of educational supervision; review of modern secondary school methods of teaching; common techniques of supervision; evaluation of teaching and learning.
548. Educational Policy Making and Interpretation. (3-0) Cr. 3. W.S.SS. Prerequisite: 541. Engel. Historical and legal bases of educational governments in the United States; current issues in educational policy making at the local, state, and national levels; problems of implementing policy and interpreting educational programs to the community.

549. Planning Public School Facilities. (3-0) Cr. 3. S.SS. Prerequisite: 541. Hart. Assessment of need for new buildings; selection and acquisition of site; selection of architect; educational specifications; construction of new buildings.

551. Occupational Information. (3-0) Cr. 3. F.W.SS. Prerequisite: 552A: Fifteen credits in education and psychology. Bryan, Hopper, Jones. Methods and techniques of occupational analysis; description and presentation of analysis; description and presentation of occupational information to high school pupils. Growth and development of important occupations, statistics, and trends. For teachers and counselors. Field trips to industrial plants.

552A, 552B, 553. Educational Statistics. (3-1) Cr. 3 each. F.W.SS. Prerequisite: 552A: Fifteen credits in education, five credits in mathematics; 552B: Fifteen credits in education; 553: 552A. Howe, Netusll. Statistical concepts and procedures for analyzing educational data. Designed for teachers, school administrators, or educational research workers. Concepts of descriptive and inferential statistics are stressed.

555. Organization and Administration of Junior High-School. (2 or 3-0) Cr. 2 or 3. W.SS. Prerequisite: 426. Manatt. Current practices and trends in the organization of the junior high school, including underlying psychological and educational theory. Responsibilities of the junior high school principal for scheduling, selection, and leadership of teaching personnel; records and reports; extracurricular activities; discipline; business administration.

556. Administration of Area Vocational-Technical Schools and Community Colleges. (3-0) Cr. 3. W.S.SS. Prerequisite: 541, 543, 548 or equivalent. Brown. Scope, administration, organization, and evaluation of programs for area vocational-technical schools and community colleges.

560. Higher Education in United States. (3-0) Cr. 3. F.SSSI. Brown. A survey course including historical development, institutional governance, multiplicity and diversity of colleges, administrative structure, organization, trends, and issues. A prerequisite for other courses in higher education.

561. Methods of College Teaching. (2 or 3-0) Cr. 2 or 3. F.SSSI. Prerequisite: Fifteen graduate credits. Kizer. Basic educational theory and methods; abilities essential to effective teaching.

562. Curriculum and Instruction in Higher Education. (3-0) Cr. 3. W.S.SSI. Prerequisite: Fifteen graduate credits. Brown. Issues, trends, and principles in curriculum development; experimental programs; interrelationships of general and specialized education; liberal education; professional education.

563. College Personnel Policies and Practices. (3-0) Cr. 3. S.SSSI. Prerequisite: 660. Brown. A profile of the college teacher, his special problems, interests, and goals; an examination of personnel problems in colleges and universities, including community colleges. In-service development, salaries, fringe benefits, promotion, tenure, retirement, and recruitment will also be discussed.

564. Student Personnel Services in Higher Education. (3-0) Cr. 3. W.SS. An introduction to the field of student personnel work, with a consideration of student activities, counseling services, financial aid, admissions, student conduct, and residential programs. Includes study in community college programs.

565. Organization and Administration of Student Personnel Services in Higher Education. (3-0) Cr. 3. S.SS. Organizational structures considered; role and functions of members of student personnel staff; policies and decision making for student personnel services emphasized.

570. Program Planning in Adult Education. (3-0) Cr. 3. F. Prerequisite: 566. Beavers. Principles and procedures in identifying and appraising program opportunities in adult education. Emphasis will be upon involvement of participants and integration of information in selecting program objectives.

575. Fundamentals of School Law. (3-0) Cr. 3. S.SS. 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.

576A, 576B. Duties of School Principals. (2 or 3-0) Cr. 2 or 3. F. S.SS; W.SS. Prerequisite: 541. 576A: Hobl; 576B: Engel, Manatt. 576A: Elementary school organization for teaching and learning. Time allotments, staff utilization, team teaching, and student control. Executive and planning functions of the elementary school principal. Historical perspectives of this management profession. 576B: Secondary school organization, schedule making, management of pupil organizations, evaluation of pupil growth. Evaluation of the total program, staff utilization, and leadership.

584A, 584B. History of Education. (2 or 3-0) Cr. 3. F. S.SS. Prerequisite: Fifteen credits of graduate work. Kizer, Kniker, Smith. 584A: History of European Education. Educational practices and institutions in ancient Greece and Rome; medieval educational patterns; rise of universities; Impact of the Renaissance, Reformation, and Counter-Reformation; development of national systems of education with special attention to England, France, and the German area. 584B: History of American Education. European heritage; colonial institutions and practices; influences from Enlightenment; Jacksonian democracy and the rise of tax support and state supervision; response to industrialization; educational reform movements; twentieth century developments and trends.

586. Comparative Education. (3-0) Cr. 3. S.SI. Prerequisite: Fifteen credits of graduate work. Smith. Development, principles, and uses of comparative education; comparative analysis of selected educational systems, practices, objectives, and problems; specific countries treated will vary from time to time.

590. Special Topics. Cr. 1 to 5. Prerequisite: Fifteen credits in education.

591. Supervised Field Experience. (0-3 to 9) Cr. 1 to 3. F.W.SS. Prerequisite: Fifteen credits graduate work in special area. Supervised on-the-job field experience in special areas.

592. Supervised Practice in Counseling. (1-6 to 8) Cr. 3 or 4. F.W.SS. Prerequisite: 592A: 593A, 593B or C. permission of instructor; 592B: Six credits of 592A and permission of instructor.
A. Counseling Practicum.
B. Supervision of Counseling Practicum. Educ 582B is primarily a doctoral level course and will be taken by students who plan to pursue counselor education careers. Because of the importance attached to the counseling practicum in most counselor education institutions, skills in supervision of practice are necessary for a doctoral student seeking employment.

COURSES

663. Workshop. Cr. 1 to 5. SS. Prerequisite: Fifteen credits in education.
B. Adult Education. Beavers, Holmes, Lawrence.
C. Secondary Education. Dills, Manatt, Schoerke.
E. Administration of Education. Dills, Engel, Hart, Holmes, Manatt.
F. Supervision. Manatt.
G. Research and Evaluation. Howe, Netuull.
I. Elementary Education. Beard, Merkley.
N. Curriculum. Dills.


Courses for Graduate Students, major or minor


602. Current Educational Issues. (2 or 3-0) Cr. 2 or 3.
W. Prerequisite: Fifteen credits in graduate work in education. Kizer. Selected educational issues, movements, or problems in contemporary American education.

603. Philosophical Ideas in American Education. (3-0) Cr. 3. S. Prerequisite: 601. Kizer. An intensive analysis and criticism of selected educational theories and issues. Synthesis and evaluation of their bearing on educational theory and practice.

615. Seminar. (1 to 3-0) Cr. 1 to 3. F.W.S.
B. Adult Education.
C. Secondary Education.
D. Guidance.
E. Educational Administration.
F. Supervision.
G. Research and Evaluation.
I. Elementary Education.
L. Higher Education.
N. Curriculum.
P. Philosophy, History, and Comparative Education.


643. The Administration of School Personnel II. (3-0) Cr. 3. S. Prerequisite: 543. Engel. An in-depth exploration of problems in the administration of school personnel in relation to current theories and practices. Topics will include collective negotiation, differentiated staffing, and personnel selection and maintenance.

644. Educational Finance. (2-4) Cr. 2 to 4. S. Prerequisite: 541. Hart. Application of the principle of public finance to education; school revenues and expenditures as part of the fiscal problem of government at the local, state, and federal levels.

663. Research in the Analysis of Teaching. (3-0) Cr. 3. S. Prerequisite: Nine credits of graduate work in education. Dills, Schoerke. Critical examination of various systems for studying and evaluating teaching; descriptive studies and conceptual systems of teaching; their nature and possible uses; major research attempts in assessing teaching effectiveness along with ensuing problems connected with such efforts.

664. College Organization and Administration. (3-0) Cr. 3. F. Prerequisite: 560. Brown, Gowan. Lectures and discussions relating to administrative organization and behavior: communications, leadership, distribution of power, institutional report writing, job analyses, legal bases, and institutional governance.

665. Financing Higher Education. (3-0) Cr. 3. W. Prerequisite: 560. Brown. Lectures, discussions, and individual investigation relating to financial administration in colleges and universities. Budgeting, space utilization, administration of sponsored research, fund raising, investments, examination of theories on expenditures. Designed for persons aspiring to college administration.

678. Administrative Theory in Education. (3-0) Cr. 3. S. Prerequisite: Master's degree, permission of instructor. Manatt. The historical background of current thinking in administration and organization; theoretical approaches to administration; analysis of functions and processes of administration as they apply to education. For experienced administrators.

679. Advanced Administrative Theory in Education. (3-0) Cr. 3. S. Prerequisite: 678. Manatt. Critical evaluation of the major research in systems analysis, operations research and prediction models as they apply to the management of schools and colleges. Simulation by in-basket techniques and computer. Model building from isomorphisms selected from management strategies in business and industry.

680. The Teaching-Learning Process in Adult Education. (3-0) Cr. 3. S. Prerequisite: 570. Lawrence. Inquiry into psychological and sociological factors in adult behavior as they affect learning; special emphasis on differences between adults and youth as learners and their implications for adult teaching. The inductive approach to adult learning will be emphasized.

699. Research. Cr. arr. Prerequisite: Fifteen credits in education.

Electrical Engineering

Warren B. Boast, Head of Department


Associate Professors: Baker, Bond, Bowen, Brearley, Brockman, Joseph M. Brown, Carlson, Fanslow, Mericle, Michel, Musil, Samuels, Scott, Soutien, Smay, Stephenson, Willett, Zingg.
Assistant Professors: Basart, Coady, Comstock, Cowan, Duven, Herget, Horton, Kruepemel, Lacey, Lucas, McMechan, Muir, Pavlat, Swift.

Instructors: Russell D. Anderson, Crow.

Undergraduate Study

For undergraduate curriculum in electrical engineering leading to the degree Bachelor of Science, see College of Engineering, Curricula.

Electrical engineers engage in research, development, design, application, management, and sales in electrical and associated industries. They apply the theories, circuits, and materials of electrical engineering toward improvements in all of the range of electrical devices, methods, and systems that render a service to mankind.

The curriculum in electrical engineering has been designed to enable the individual to develop his imagination and knowledge so that he can enter any of these fields according to his incentive, initiative, and talents.

Graduate Study

The department offers work for the degrees Master of Science, Master of Engineering, and Doctor of Philosophy with major in electrical engineering and minor work to students taking major work in other departments.

Minor work for electrical engineering majors is usually selected from mathematics, physics, chemistry, nuclear engineering, aerospace engineering, or the life sciences.

There is no foreign language requirement for the degrees Master of Science or Master of Engineering. The foreign language requirement for the degree Doctor of Philosophy consists of the completion, with grades of C or better, of one of the following foreign language sequences (or equivalent): 101, 102, 103 (French); 121, 122, 123 (Russian); 131, 132, 133 (German); 151, 152, 153 (Spanish).

The department also offers major work for the degree Master of Engineering. The thesis requirement may be waived. This degree is offered both on-campus and at approved off-campus locations.

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 or her 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 area of research interest. A prospective student from a discipline other than a curriculum in electrical engineering is urged to submit, with the application for admission, a statement of the proposed area of graduate study.

Courses normally will be offered as stated in the course description. Where no specific time of offering is stated, the course may be offered during any quarter provided there is sufficient demand.

Instruction in biomedical engineering is provided jointly by the colleges of Engineering and Veterinary Medicine. Laboratory facilities are available in the Biomedical Engineering Building. See Biomedical Engineering for requirements.


Courses Primarily for Undergraduate Students

100. Technical Lecture. (1-0) Cr. R; S. Current electrical engineering thought and practices presented by staff members and visiting lecturers.

200. Seminar. Cr. 1 to 3 as arranged. H. Seminar in electrical engineering for honors program students.


231. Electrical Instrumentation and Experimentation I. (1-2) Cr. 2. W.S. Prerequisite: Credit or classification in 205. Systems for measurement of electrical quantities—voltage, current, power, time, impedance.

232. Electrical Instrumentation and Experimentation II. (1-2) Cr. 2. F.S. Prerequisite: 231, credit or classification in 206 and Com S 201. Experiment design and evaluation; applications to electrical measurement problems.

300. Seminar. (1-0) Cr. R; S. Prerequisite: Junior classification.


313. Introduction to Electromagnetic Fields. (3-2) Cr. 4. F.S. Prerequisite: Phys 223, credit or classification in Math 321. Vector analysis, principles of electrostatic fields, energy and potential, capacitance, Laplace's equation and application to static and quasi-static problems, numerical solutions of Laplace's equation.
190 COURSES AND PROGRAMS

314. Introduction to Electromagnetic Fields II. (3-2) Cr. 4. F.W. Prerequisite: 313. Credit or classification in Math 322. Principles of magnetostatic fields, magnetic circuits, inductance, Faraday's Law, displacement current, Maxwell's equations, introduction to wave concepts and energy flow in transmission lines and electromagnetic waves.

315. Television Fundamentals. (3-0) Cr. 3. W. Prerequisite: Sp 331. Fundamentals of electronics. Radio and television broadcasting systems, standards and equipment, including the NTSC system. Cannot be used to meet graduation requirements for students in the College of Engineering.


318. Power Circuit and Magnetic Device Laboratory. (0-2) Cr. 1. W.S. Prerequisite: Credit or classification in 317. Experiments in balanced three-phase circuits, magnetic devices, and iron-core transformers.

341, 342. DC and AC Circuits and Machines. (3-2) Cr. 4 each. 341: F.; 342: W. Prerequisite: 341: Phys 223, Math 222 or 223; 342: 341. 341: Introduction to direct and alternating current circuit analysis. Basic circuit laws and network theorems. Three-phase circuits. Basic circuit measurement. 342: Transformer, introduction to DC machines, three-phase induction machines, synchronous machines, and single-phase machines. This sequence is designed primarily for students in engineering operations and construction engineering. The department recommends that credits in both the 341, 342 and the 441, 442, 451 sequences not be applied toward graduation.

351. Electric Machinery. (3-0) Cr. 3. F.S. Prerequisite: 317, credit or classification in 309. Analysis of rotating electric machinery with emphasis on applications.

352. Electric Machinery Laboratory. (0-3) Cr. 1. F.S. Prerequisite: Credit or classification in 318 and 351. Experimentation with electric rotating machinery.

374, 375, 376. Electronics Engineering. (3-3) Cr. 4 each. 374: F.S.; 375: F.W.; 376: W.S. Prerequisite: 374: 208, credit or classification in 233; 375: 374, credit or classification in 308; 376: 375, credit or classification in 308. Introduction to transistor physical electronics. Linear, piecewise-linear and large-signal modeling of selected electronic devices. Analysis of electronic circuit topics such as biasing, amplification, frequency characteristics, distortion, power dissipation, feedback effects, oscillation, switching. The department recommends that credits in both the 374, 375, 376 and the 445, 456 sequences not be applied toward graduation.

404. Introduction to Linear Control Systems. (3-0) Cr. 3. F. Prerequisite: Math 332. Introduction to the representation and analysis of linear control systems by means of transfer functions and state equations.

410. Introduction to Switching Theory. (Com S 410) (3-0) Cr. 3. F. Axiomatic development of Boolean algebras. Combinational circuits using AND, OR, NOT and other logical elements, truth tables, maps, minimization techniques. Introduction to asynchronous sequential circuits, stable and unstable states, state diagrams, flow tables, simplification methods.


420. Electromagnetic Waves. (3-3) Cr. 4. F. Prerequisite: 314. Plane waves, energy flow, normal and oblique incidence, phase and group velocities, propagation between parallel planes, dispersion and the $\psi$ diagram, polarization, interference and diffraction, partial coherence, propagation in anisotropic media.

421. Transmission Lines and Guided Waves. (3-3) Cr. 4. W. Prerequisite: 420. Properties and applications of transmission lines in power and communication systems, transients, impedance matching, matrix representation, transmission-line-line transformers, filters and couplers, applications to wave guides.

425. Linear Integrated Circuits. (3-0) Cr. 3. W. Prerequisite: 375. Analysis and application of linear integrated circuits, including such topics as chip fabrication, monolithic differential and operational amplifiers, active filters, switching regulators, data sheet specifications.

426. Pulse and Digital Circuits. (3-3) Cr. 4. F. Prerequisite: 376. The diode and active devices in switching applications. Analysis and design of pulse and digital circuits such as logic elements, multivibrators, logic elements.


428. Electrical Properties of Materials. (4-0) Cr. 4. S. Prerequisite: Phys 303. Electrical properties of metals, semiconductors, insulators, and magnetic materials as utilized in device applications such as lasers and integrated circuits.

431. Electrical Energy Sources. (3-0) Cr. 3. W. Prerequisite: 308 or 341, and Phys 306. Specialized and unconventional sources of electrical energy such as photovoltaic generators (solar cells), thermoelectric converters, and magneto-hydrodynamic generators. Other energy conversion schemes.


441, 442. Introduction to Circuits and Instruments. (3-2) Cr. 4 each. 441: F.W.; 442: W.S. Prerequisite: 441: Phys 222, credit or classification in Math 213; 442: 441: Transient and steady state behavior of circuits. Use of the Laplace transform, the phasor transform, and the transfer function in circuit analysis. Basic instruments. 442: Frequency response, bridge circuits, magnetically coupled circuits, transformers, three-phase circuits, periodic driving functions. The department recommends that credits in both the 431, 432 and the 441, 442, 451 sequences not be applied toward graduation.

445, 446. Electronic Circuits, Instruments, and Systems. (3-3) Cr. 4. W.S.; 446: (3-2) Cr. 4. S. Prerequisite: 445: 342 or 441; 446: 445. 445: Introduction to electronic circuit analysis; diode and triode circuits; transistor circuits. 446: Digital systems and instrumentation. The department recommends that credits in both the 374, 375, 376 and the 445, 446 sequences not be applied toward graduation.

451. Introduction to Electric Machinery. (3-2) Cr. 4. F.S. Prerequisite: 442. Power transformers. Basic principles of operation, design, and control of DC machines, induction machines, synchronous machines, and single-phase machines.

460. Introduction to Energy Systems. (4-0) Cr. 4. S. Prerequisite: Senior classification. Electric energy requirements, structure of energy systems, energy resources, structure of bulk conversion schemes, thermal generation, hydro generation, future generation, economics of generation, structure of transmission systems, operation, environmental effects.
Courses Primarily for Graduate Students, major or minor, open to qualified undergraduates

505. 506. Analysis and Design of Linear Control Systems. (3-0) Cr. 3 each. Offered as arr. Prerequisite: 505: 404, Com S 201; 506: 505, credit or classification in 475. Definition and application of root-locus, Bode, Nyquist, and Nichols plots; stability of feedback systems; compensation to meet time and frequency domain performance criteria; applications of digital and analog computers in solving control systems problems; practical design problems.


525. Introduction to Gas and Plasma Electronics. (3-0) Cr. 3. Offered as arr. Prerequisite: 314, Phys 303. Ionization processes; diffusion and recombination; electron attachment; behavior of charged particles in fields; mobility; self-sustained processes; breakdown; glows; arcs and coronas; microwave breakdown; plasma oscillations; plasma interaction with electromagnetic waves; applications.


528. Data Transmission. (3-0) Cr. 3. S. Prerequisite: Math 322. Principles of modern data communications. Optimum spectral shaping of data signals to achieve minimum error rate in the presence of noise. Theoretical error rates for various modulation methods. Commonly-encountered transmission impairments and their effects. Characteristics of various systems are compared theoretically and practically.


532. Synthesis of Electric Networks. (3-0) Cr. 3. Alt. Yr. as arr. Prerequisite: 509. Necessary and sufficient conditions and synthesis methods for realization of passive driving point functions.


539. Matrix Network Analysis. (3-0) Cr. 3. F. Prerequisite: 309 or 442. Matrix analysis of networks, port and terminal descriptions, linear vector space formulation and applications.


541. Advanced Symmetrical Components. (3-0) Cr. 3. Alt. Yr. as arr. Prerequisite: 467. Calculation of sequence impedances, analysis of unbalanced systems and unbalanced conditions.

542. Power System Protection. (3-0) Cr. 3. Alt. Yr. as arr. Prerequisite: 541. Criteria for fault clearing, device coordination, relaying.

543. Computer Solutions for Power Systems. (3-0) Cr. 3. Alt. Yr. as arr. Prerequisite: 541, 404, or 539. The study of algorithms adaptable to digital computers for load flow, fault, and stability problems.

544. Distribution Engineering. (3-0) Cr. 3. Alt. Yr. as arr. Prerequisite: 457. Distribution components, design criteria, protective device coordination, secondary networks, voltage control.

545. Economic Operation of Power Systems. (3-0) Cr. 3. Alt. Yr. as arr. Prerequisite: 538. Operation of systems on a minimal cost basis, theory of incremental loading, system losses, methods of computation.

547. High Voltage DC Transmission. (3-0) Cr. 3. Alt. Yr. as arr. Prerequisite: 314. Transmission by direct current inverters, system simulation, parallel operation, stability considerations.

550. Static Electric and Magnetic Fields. (3-0) Cr. 3. F. Prerequisite: 314. Electrostatic and magnetostatic fields in vacuum, boundary conditions, relations of microscopic and macroscopic fields, general solutions of potential problems, energy-force relations, fields in conducting, dielectric, and magnetic materials.

551, 552. Advanced Electromagnetic Field Theory I, II. (3-0) Cr. 3 each. 551: W; 552: S & Prerequisite: 551: 420; 552: 551. 551: Theorems and concepts in electromagnetic theory; scattering, radiation, plane, cylindrical, and spherical wave functions. 552: Perturbational and variational techniques, periodic structures, propagation in anisotropic media.

554. Microwave Engineering. (3-0) Cr. 3. Alt. Yr. as arr. Prerequisite: 421. Waveguides, cavity resonators, passive microwave devices, cascaded transformers and couplers, microwave filters, microwave tubes, microwave semiconductor devices.

556. Antenna Engineering. (3-3) Cr. 4. Alt. Yr. as arr. Prerequisite: 420. Transmission of electrical energy via antennas in space and in the presence of the earth's surface. Radiation from simple and extended sources and arrays, antenna theorems, analysis and design, scanning concepts, receiving antenna considerations, modern antenna systems.

557. Fundamentals of Radio Wave Propagation. (3-0) Cr. 3. Alt. Yr. as arr. Prerequisite: 420. Transmission
loss, free-space propagation, propagation over plane and spherical surfaces, propagation at low frequencies, microwave and millimeter wave propagation, laser beam propagation.

558A, 558B. Radio Astronomy. (3-0) Cr. 3 each. Prerequisite: 556A: Phys 223 or 303; 558B: Credit or classification in 420 or Phys 365. 558A: Radio astronomy sources: continuum emission mechanism of radio sources; spectral radio lines; observed characteristics of the sun, galaxy, quasars, and other radio sources. 558B: Radio astronomy measurements: fundamentals of radio astronomy, radio telescope antennas, interferometer theory, wave polarization, radioneters.

560, 561, 562, 563. Systems Engineering Analysis. (3-0) Cr. 3 each. 560, 561: Yr. as arr.; 562, 563: Alt. Yr. as arr. Prerequisite: 560: Credit or classification in Math 410 or Math 415; 561: 560; 562: 561; 563: 561. Applications of topics in abstract algebra, topology, theory of measure and integration, linear algebra, and functional analysis to automatic control systems and communication systems. Utilization of selected topics in ordinary differential equations, partial differential equations, calculus of variations, integral equations and random processes in the areas of communication and control theory.


576. Sampled-Data Control System Analysis. (3-0) Cr. 3, offered as arr. Prerequisite: 506. Operational and state-space methods applied to the analysis and synthesis of sampled-data control systems.

577, 578. Linear Systems Theory. (3-0) Cr. 3 each, offered as arr. Prerequisite: 577: 404; 578: 577. Operational and state-space methods applied to the analysis and synthesis of continuous linear systems. Controllability, observability, and stability.

582. Switching Theory. (Com S 582) (3-0) Cr. 3. F. Prerequisite: 410. Review of combinational circuits. Sequential circuits, Mealy and Moore model, synchronous and asynchronous behavior, complete and incomplete machines, state minimization and state assignment procedures.

584, 585. Digital System Organization. (Com S 584, 585) (3-0) Cr. 3 each. 584: F; 585: W. Prerequisite: 584: 411; 585: 584. Influence of processing requirements on digital system structure; data flow paths in digital systems; data formats; channel organization; memory hierarchies; time sharing; interrupts and priorities; system optimization; system representation in Iverson Language.

586. Digital System Design. (Com S 586) (3-0) Cr. 3. S. Prerequisite: 412 or 585. Hardware systems simulation; advanced topics in design of arithmetic, logic, and control units; hardware system optimization; hardware/software trade-offs.

590. Special Topics. Cr. 2 to 5 each time elected. Formulation and solution of theoretical or practical problems in electrical engineering.


Courses for Graduate Students, major or minor

616, 619. Advanced Topics in Electrical Materials. (3-0) Cr. 3 each time elected. Alt. Yr. as arr. Prerequisite: 520.

A. Superconductivity.
B. Stimulated emission amplification.
C. Coupled wave phenomena.
D. Static and dynamic domain phenomena.


641, 642. High Voltage Engineering. (3-0) Cr. 3 each. 641: Alt. Yr. as arr. Prerequisite: 457, 526. Need for high voltage, high fields, ionization, AC and DC corona, voltage transformers, lightning and protection, insulator flashover, insulation coordination, circuit interruption, radio interference.


647. Specialized Electric Energy Sources. (3-0) Cr. 3 each time elected. Alt. Yr. as arr. Prerequisite: 431 or 314, 376. Study of specialized sources which convert various sources of energy into electric energy. Each time offered one of the following direct energy schemes will be discussed:

A. Photovoltaic generators (solar cells).
B. Thermionic converters.
C. Magnetohydrodynamic generators.
D. Other schemes.

651. Advanced Topics in Applied Electromagnetic Theory. (3-0) Cr. 3 each time elected. Prerequisite: Permission of instructor. Topics available include numerical solutions of electromagnetic problems, advanced theory of propagation in plasmas, advanced antenna engineering, advanced microwave engineering, radio astronomy observations, radar photography, microwave measurements and instrumentation.


694. Advanced Switching Theory. (Com S 684) (3-0) Cr. 3. Offered as arr. Prerequisite: 410, permission of instructor. Advanced topics in switching theory.

695. Advanced Logic Systems. (Com S 685) (3-0) Cr. 3 each time elected. S. Prerequisite: 586.
A. Specialized Processor Organization.
B. Pattern Recognition and Adaptive Systems.
C. Optical Systems.


699. Research.

Elementary Education

Jess R. Beard, Head of Department

Associate Professors: Merkley.
Assistant Professors: Breiter, Gilbert, Henney, Mortenson, Shirley.
Instructors: Gray, Hodges, Kline, Leonard, Murphy, Remele, Sampson, Weber.

Undergraduate Study

For the undergraduate curriculum in education, major in elementary education, leading to the degree Bachelor of Science, see Education, Curriculum.

The curriculum in elementary education is planned for persons who want to teach at the elementary school level. Students who enroll in elementary education must make application to and be accepted by the teacher education committee in elementary education and the Academic Standards Committee, College of Education, prior to classifying in advanced elementary education courses. For admission and certification requirements, see College of Education.

Graduate Study

For students seeking graduate course work leading to advanced degrees in education, see Education.

Open to graduate students for minor credit only: 450, 451, 452, 455, 456.

Courses Primarily for Undergraduate Students

100. Freshman Orientation. Cr. R; F.W.S. Opportunities in elementary education, program planning, and personal development. Required of all freshman majoring in elementary education.

200. Sophomore Orientation. Cr. R; F.W.S. Opportunities in elementary education, program planning, and personal development. Required of all sophomores majoring in elementary education.

240. Literature for Children. (C D 240) See Child Development.

290. Special Problems. Cr. 1 to 3. Prerequisite: Permission of head of department and sophomore classification.

300. Transfer Orientation. Cr. R; F.W.S. Opportunities in elementary education, program planning, and personal development. Required of all transfer students majoring in elementary education.


334A, 334B. Principles of Teaching in the Elementary School. 344A-344B 2 Cr. 344A: 0-2 1 Cr. F.W.S.SS. Prerequisite: 344A: Educ 204, Psych 333; 344B: Concurrent registration in 344A. Current trends and issues in the elementary school. Admission to the teacher education program must be completed during the quarter.

375. The Teaching of Reading. (5-2) Cr. 6. F.W.S.SS. Prerequisite: 344. Approaches to developmental teaching of reading in elementary schools: emphasis on techniques, materials, skills, literature, innovations, issues, evaluation procedures, and reading in the content areas.


444. Elementary Education Methods I. (6-0) Cr. 6. F.W.S.SS. Prerequisite: 344. Strategies for teaching social studies and language arts in the elementary school. Use of children's literature in these areas.

446. Elementary Education Methods II. (4-0) Cr. 4. F.W.S.SS. Prerequisite: 344, Math 181. Procedures for teaching mathematics and science to children. Discovery approach, innovative programs, and practical field experiences.

447. Teaching in the Kindergarten. (6-0) Cr. 3. W.SSI. Prerequisite: 344. Emphasis on growth and development, readiness for learning, planned curriculum experiences, and observation.

450. The School and the Disadvantaged Learner. (5-0) Cr. 3. F.W.SSI. Prerequisite: Psych 333, senior classification. Characteristics of the disadvantaged children of the poor; implications for school personnel in working with the child and family.

455. Teaching the Disabled Learner. (3-0) Cr. 3. W.SSI. Prerequisite: 450, 445. Techniques for assessing and teaching the handicapped child.

452. Field Experience and Practicum with Disadvantaged. (1-27) Cr. 3 to 9. F.W.S.SSI. Prerequisite: Consent of instructor. Individual study. May include study tours, working with community agencies, or teaching in schools of deprived areas.

455. Teaching the Disabled Learner. (3-0) Cr. 3. F.W.SSI. Prerequisite: 375. Emphasis on recognition of characteristics, classroom screening techniques for identification, referral procedures, teaching techniques, and materials.

456. Teaching the Emotionally Disturbed Child. (3-0) Cr. 3. S.SSI. Prerequisite: 344. Classroom screening techniques for identification, referral procedures, and classroom practices and procedures.

467C, Student Teaching in the Primary Grades. (0-24) Cr. 8. F.W.S. Prerequisite: 375, 445, 446, cumulative grade-point average of 2.3. Reservation required. Experience in teaching in the primary grades.

467D. Student Teaching in the Intermediate Grades. (0-24) Cr. 8. F.W.S. Prerequisite: 375, 445, 446, cumulative grade-point average of 2.3. Reservation required. Experience in teaching in the intermediate grades.

490. Special Problems. Cr. 1 to 5. Prerequisite: Junior classification, permission of head of department.
Engineering

David R. Boylan, Dean of Engineering
Paul E. Morgan, Associate Dean; Burton J. Gleason, Assistant to the Dean.
Professors: Black, Hillyard, Town.
Assistant Professors: Hoffman, Knight.

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 course listed is 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. Orientation. (1-0) Cr. R. 114: F. Nature of professional work in engineering and some fundamental considerations in selecting a career.

190. Special Topics. Cr. 1 to 5 each time taken. Prerequisite: Engineering classification. Experimental courses or honors seminars pertaining to topics common to more than one engineering curriculum.

200, 300, 400. Cooperative Education. Credit: Required of all cooperative students in engineering. Prerequisite: Permission of department head. 200: Work periods for students with sophomore standing in a regularly established cooperative work-study program in any engineering curriculum. 300: Work periods for juniors. 400: Work periods for seniors. Students must register for these courses prior to commencing each work period.

431A, 431B. History of Engineering. (Hist 431A, 431B) (3-0) Cr. 3 each. 431A: F.W.; 431B: W.S. Prerequisite: Junior classification. 431A: A Half-made World: The growth and limits of mankind's artificial environment as determined by technological change and engineering enterprise from prehistoric times to the eve of the industrial revolution. 431B: Technology and engineering in the transformation of Western Civilization from the Industrial revolution to the present.

Courses Primarily for Graduate Students, major or minor, open to qualified undergraduates

518. History of Technology in the United States. (Hist 518) (3-0) Cr. 3. S. Prerequisite: 431B. A mastery of means: Technological innovation and social change in American civilization from its beginnings until now.

561. Technology in Developing Countries. (Hist 561) Cr. 3. F. Prerequisite: 431B. Historical review of technological development of developing countries, with emphasis upon United Kingdom, U.S., and Japan; factors affecting rate of development; analysis and comparison of current technological status of selected cultures in America, Africa, and Asia.

590. Special Topics in the History of Technology. Cr. 2 to 5. Prerequisite: Nine credits in history of technology.

Engineering Graphics

C. Gordon Sanders, Chairman of Department

Professors: Almfeldt, Rising (Emeritus).
Associate Professors: Armbal, Crawford, Defiong.
Assistant Professors: Butler, Dowling, Eide, Ellingson, Granneman, Mercier, Sayre.
Instructor: Geringer.

Undergraduate Study

Engineering graphics is a visual method of expressing ideas by means of projections, graphs, and diagrams in order to gain, interpret, or communicate technical knowledge.

Engineers often use graphical procedures to translate mathematical solutions into a picture form that may be more understandable and more logically followed and verified than the mathematical form. Designers use graphics as a memory-fixing device while ideas are being considered and refined—as a visual retention of alternate solutions for comparative analysis. As a means of communication, graphics facilitates visual descriptions of objects or relationships that are compact, precise, and readily interpreted.

Proper training in graphics develops an individual's ability to visualize and comprehend the nature of systems and things, to think rationally and imaginatively, and to communicate ideas and technical information effectively. The engineering graphics courses provide frequent opportunities to express creative talents and give the student important background training in preparation for various other disciplines.

Courses Primarily for Undergraduate Students


162. Foundation for Engineering Design. (2-4) Cr. 3. W.S. Prerequisite: 161. Elements in the design process with emphasis on fundamental procedure and stimulation of creativity. Graphical topics related to the design process. Application of the design process through an open end project, and integrated with various modes of communication. An introduction to mechanical and electronic devices used to aid design.

235. Advanced Graphical Problems. (0-3 to 15) Cr. 1 to 5. S. Prerequisite: 162, and permission of department head. Advanced graphical theory and application tailored to any area of need considered satisfactory by both the student and his major department advisor. Some example topics are: patent drawings, design layout drawing, true position dimensioning and geometric tolerancing, advanced
Engineering Journalism

Administered by the Department of Industrial Engineering in cooperation with the Department of Journalism and Mass Communication.

A program in engineering journalism has been designed in the engineering operations curriculum for students who desire a knowledge of the fundamentals of management, engineering, science, communications, and human behavior, and who do not wish to pursue the more specialized engineering curriculum. Graduates of this program should find interesting opportunities in a number of administrative areas in industry such as technical information, industrial communications, public relations, engineering sales, procurement, and production.

The program is administered in the Department of Industrial Engineering and leads to the degree Bachelor of Science with major in engineering journalism. Additional information concerning the journalism courses and requirements may be obtained from the head of the Department of Journalism.

Required courses in the engineering journalism program include all the required courses in the engineering operations curriculum except as noted below.

The following number of credits in journalism must be included for the engineering journalism program:

101. Introduction to Journalism
2 credits

201, 202, 203. Basic Journalism
11 credits

300-level courses
12-14 credits minimum

400-level courses
9 credits minimum

490J. Special Problems in Journalism
3 credits

Total 37 credits minimum

A 400-level journalism course, preferably 430, may be substituted for Engl 365A, and a 300-level course, preferably 360, for Engl 414. Two courses selected from 425, 431, 440, 462, and 464 may be taken as socio-humanistic electives, and four other 300- and 400-level courses as management-business electives.

The minimum number of credits required for graduation in the engineering journalism program is 190.

Engineering Science and Mechanics

Harry J. Weiss, Head of Department

Professors: Davis, Gilkey, Nariboli, Riley, Young. Associate Professors: Burger, Graham, McConnell, Petersen, Rogge, Smith, Sun, Yu-Min Tsai. Assistant Professors: Bertram, Schmerr, Frank Tsai, Wood.

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. Students are expected to gain some insight into the background of purchase and design specifications. Physical properties of engineering materials are studied in the classroom and are evaluated in the laboratory. General laws, such as those of Newton, are given mathematical expression and are made suitable for use in the solution of specific problems in machine and structural design, and in the flow and measurement of fluids.

Graduate Study

The department offers work for the degrees Master of Science, Master of Engineering, and Doctor of Philosophy with major in engineering mechanics, and minor work to students taking major work in other departments. The Master of Engineering degree is primarily a terminal master's degree, without thesis. There is no foreign language requirement for either master's degree or the Doctor of Philosophy degree.
Courses Primarily for Undergraduate Students

274. Statics of Engineering. (3-0) Cr. 3. F.W.S.S. Prerequisite: Math 223 or 233; credit or classification in Phys 221. Vector and scalar treatment of coplanar and noncoplanar force systems. Resultants, equilibrium, friction, centroids, moments and products of inertia of areas, Mohr’s circle. The department recommends that credit in both 274 and 275 not be applied toward graduation.

275. Scalar Statics. (3-0) Cr. 3. F.W. Prerequisite: Phys 111, Math 122 or 132, or 182. Scalar treatment of coplanar and noncoplanar force systems. Resultants, equilibrium, friction, centroids, moments and products of inertia of areas, Mohr’s circle. The department recommends that credit in both 274 and 275 not be applied toward graduation. This course is not acceptable as a prerequisite for 345.

301, 302. Mechanics I and II. (3-0) Cr. 3 each. 301: F.W.S.S.; 302: F.W.S.S. Prerequisite: 301. Math 223 or 233. 301: Newton’s Laws, units, equilibrium of rigid and deformable bodies, stress. Kinematics of particles and rigid bodies. 302: Deformation and strain in solids and fluids, rigid body dynamics, constitutive equations for solids and Newtonian fluids. Applications to tension, torsion, and flexure of solid bars. For students desiring a terminal two-quarter sequence in mechanics. E M 301 and 302 should not be used for credit toward graduation for students who have completed E M 326 or E M 346 or their equivalent.

324. Strength of Materials. (5-0) Cr. 5. F. S. Prerequisite: Math 223 or 275. Plane stress, plane strain, stress-strain relationships, and elements of material behavior. Elements of stress and deformation analysis applied to members subject to centric, torsional, flexural, and combined loadings. Elementary considerations of theories of failure, buckling, repeated and impact loads. The department recommends that credit in both 324 and 326 not be applied toward graduation.

325. Mechanics of Materials I. (3-0) Cr. 3. F.W.S.S. Prerequisite: 274 or 275. Plane stress, plane strain, stress-strain relationships, and elements of material behavior. Elements of stress and deformation analysis applied to members subjected to centric, flexural, and torsional loads. The department recommends that credit for both 324 and 326 not be applied toward graduation.

326. Mechanics of Materials II. (3-0) Cr. 3. F.W.S.S. Prerequisite: 325. Continuation of 325. Advanced topics on stress and deformation analysis of members subjected to torsional, flexural, and combined loading. Elementary considerations of theories of failure, buckling, repeated and impact loads.

*327. Materials Laboratory. (0-9) Cr. 1. F.W.S.S. Prerequisite: 325 or credit or classification in 302 or 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 354; 325. or credit or classification in 302 or 324. Similar to 327 with additional topics, and added emphasis on concrete.

345. Dynamics I. (3-0) Cr. 3. F.W.S.S. Prerequisite: Math 213. Position, displacement, velocity in rectangular and polar coordinates; rigid body kinematics, Newton’s Laws of motion, moments and products of inertia, plane rigid body motion. Work-energy; linear and angular impulse-momentum for plane rigid body motion.

346. Dynamics II. (3-0) Cr. 3. F.W.S.S. Prerequisite: 345. Further work with linear and angular impulse-momentum, variable mass motions, impact problems, curvilinear motions, rotating coordinates, D’Alembert’s Principle, eccentric plane rotations, gyroscopes. Free and forced vibrations.

364. Engineering Materials. (3-0) Cr. 3. F.W.S. Prerequisite: Credit or classification in 302, or 324, or 325. Properties, uses, and manufacture of metals, timber, stone, clay products, cements, concrete, and other engineering materials.

Courses Primarily for Graduate Students, major or minor, open to qualified undergraduates


514. Advanced Mechanics of Materials. (3-0) Cr. 3. F.S. Prerequisite: 324 or 325. Theory of stress and strain, stress-strain relationships. Limitations of flexure and torsion formulas, unsymmetrical bending, curved beams, cross shear, shear center. Torsion of thin-walled and noncircular sections. Theories of failure, membrane stresses in shells, thick-walled cylinders.


517. Experimental Stress Analysis. (3-2) Cr. 4. W. Prerequisite: 324 or 326. Fundamental concepts of strain
measurement, properties of Stresscoat and its application, wire, foil and semi-conductor strain gages, strain gage circuits and recording Instruments, root note analysis, pattern recogniti-
onal potential oblique techniques, principal stress separation using shear difference, oblique incidence and other methods, birefringent coatings, scattered light, design of models, moire methods and their application.


518. Experimental Methods of Motion Measurement. (3-2) Cr. Alt. S., offered 1975. Prerequisite: 517, 544. Description, specifications, limitations, applications of mechanical, electrical, and optical transducers used in motion measurements applied to steady state, transient, and shock motions. Calibration, signal conditioning, and transducer systems used to obtain reliable and reproducible experimental data. Seismic and absolute references for motion measurement.


555. Linear Wave Propagation. (3-0) Cr. Alt. F., offered 1973. Prerequisite: 506. Surfaces of discontinuity, wave-fronts, characteristics, retarded potentials; reflection and refraction; anisotropy; dispersion and damping; phase velocity and group velocity; asymptotic methods.


569. Introduction to Linear Viscoelasticity. (3-0) Cr. 3-4. Alt. F., offered 1974. Prerequisite: 694. Definition of linear viscoelastic material; simple mechanical models; general-ized Maxwell body, Kelvin-Voigt constitutive laws. Boundary value problems, transform methods, correspondence principle, variational techniques.

571, 572, 573. Advanced Fluid Mechanics. (ME 571, 572, 573) 571: (3-2) Cr. 4. Cr. 572: (3-0) Cr. Alt. W.; 573:

Courses for Graduate Students, major or minor

604. Advanced Topics in Analytical Methods in Mechanics. Prerequisite: Math 321, 322 or equivalent, and permission of instructor. (3-0) Cr. Alt. W., offered 1974. Elements of geometry of the integrals and approximate solutions to Navier-Stokes equations for one- and two-dimensional laminar flow problems, both steady and unsteady flows; exact and approximate solutions to one- and two-dimensional boundary layers; introduction to turbulent boundary layers.

590. Special Topics. Cr. 2 to 5 each time taken.

593, 594, 595. Theory of Elasticity. (3-0) Cr. 3 each. 593: Alt. F.; 594: Alt. W.; 595: Alt. S., offered 1974-75. Prerequisite: 593: 324 or 325; 594: 593; 595: 594, credit or classification in Math 411. Fundamental relations of elasticity, uniform and nonuniform states of stress; Airy's function; application to engineering problems.

Courses for Graduate Students, major or minor

604. Advanced Topics in Analytical Methods in Mechanics. Prerequisite: Math 321, 322 or equivalent, and permission of instructor. (3-0) Cr. Alt. W., offered 1974. Elements of geometry of the integrals and approximate solutions to Navier-Stokes equations for one- and two-dimensional laminar flow problems, both steady and unsteady flows; exact and approximate solutions to one- and two-dimensional boundary layers; introduction to turbulent boundary layers.

620. Seminar. (1-0) Cr. L

630. Continuum Mechanics I. (3-0) Cr. Alt. W., offered 1974. Prerequisite: Math 322, Cartesian tensors; theorems of Green, normals, boundary values, principal values and Cayley-Hamilton theorem; isotropic tensors, tensor fields, and orthogonal curvilinear coordinates; the stress tensor, simple kinematics, and conservation laws leading to constitutive laws for elasticity and fluid mechanics.

631. Continuum Mechanics II. (3-0) Cr. Alt. S., offered 1975. Prerequisite: 630. General tensors; curvilinear coordinate systems; kinematics, nonlinear elasticity, non-Newtonian fluids; objectivity, representation theorems, introduction to hyperelastic and viscoelastic materials.

635. Rheology. (3-0) Cr. Alt. W., offered 1975. Prerequisite: 631. Finite deformations; large strains, Green's right and left strain tensors. Elastic and hyperelastic materials; energy tensors, critical points, and method of solution. Small strains superimposed on large initial strains. Introduction to hyperelasticity, finite viscoelasticity, and elastic fluids.


650. Fluid Mechanics Seminar. (ME E 650, AER E 650) (1-0) Cr. 1 to 3 each time taken. Prerequisite: Permission of instructor. Special topics of current research interest to students and staff of departments concerned.

651, 652, 653. Advanced Theoretical Aspects of Fluid Mechanics. (3-0) Cr. 3 each. Alt. Yr., offered 1974-75. Prerequisite: 571: 571; 572: 573; 573: 571: 651, 652: 653, 651: Compressible flow; General considerations, theory of characteristics, shocks, destruction and deflagration waves, shock structure, similar solutions. 652: Viscous flow; Asymptotic methods in low and high Reynolds number flows, linear and nonlinear stability. 653: Turbulence: Isotropic turbulence, shear flows, jets and wakes, other recent theo-
Graduate Study

Minor work is available to students taking major work in other departments.

Open to graduate students for minor graduate credit only: 351, 352, 353, 481, 482, 483, 484, 490, 491.

Courses Primarily for Undergraduate Students

100. Technical Lecture. (1-0) Cr. R.

211, 212. Energy Sources and Utilization. (3-0) Cr. 3 each. W.S. Prerequisite: 211: Math 223 or 233, Phy 222; 212: 211. Sources of energy, methods of utilization and transformation.

224. Application of Thermochemistry to Engineering Systems. (3-0) Cr. 3. S. Prerequisite: Chem 322. Application of thermodynamic properties, phase behavior, and kinetics of ideal and real substances to a broad class of engineering problems.

351. Engineering Materials. (3-2) Cr. 4. W. Prerequisite: Credit or classification in E M 325. Resistance of materials to failure, definitions and evaluation of properties, relationship to design. Effects of environment on properties. Laboratory determinations.


401, 402, 403. Seminar. (1-0) Cr. R; F.W.S. Prerequisite: Senior classification.

481, 482, 483. Engineering Analysis. (3-2) Cr. 4 each. F.W.S. Prerequisite: Chem 321, E M 325, 345. Application of the engineering sciences to the analysis of components and systems.


490. Special Problems. Cr. 2 to 5. Prerequisite: Permission of department head. Investigation of an approved problem commensurate with the training, interest and ability of the student. H. Honors.

491. Engineering Design. (1-6) Cr. 4. S. Prerequisite: Credit or classification in 483. Design problems in engineering science.

English

Donald R. Benson, Chairman of Department


Associate Professors: Phillips G. Davies, Fuller, Gustafson, Haggard, Johnson, Hazel Lipa, Nostwich, Speer, Zbaracki.


Undergraduate Study

For the undergraduate curriculum in sciences and humanities, major in English, leading to the degree Bachelor of Arts or Bachelor of Science, see Sciences and Humanities, Curriculum.

The study of English is the study of our basic medium of understanding and communication, our language. It is designed to develop students' awareness and appreciation of the ways language functions in the writing of others, especially in imaginative literature, and of the ways it may function effectively in their own writing. This study is available through a wide variety of general education courses in literature, language, and composition, as well as in a major program.

Basic instruction in the department is designed to establish the proficiency in communication and comprehension which is necessary for successful college work. (See College of Sciences and Humanities, Curriculum.) The department conducts a writing clinic for students beyond the freshman level and a developmental reading laboratory (see English 200).

Students graduating with a major in English can qualify for a variety of positions in business and public service; e.g., in advertising, sales, public relations, personnel, and technical writing. An undergraduate major in English is a good basis for professional study in law, theology, or medicine. Students interested in teaching can qualify to teach English in secondary schools (see College of Education for the University statement of requirements for teacher certification) or to pursue graduate study in English as a preparation for eventual teaching in a college or university.

The major requirements are quite flexible; each student works out with an adviser a program of study consistent with his or her own educational and professional objectives. The general requirements are: 45 major credits (in addition to 104-105 or 131-132); one basic course in each of the department's three main areas—literature, language, and composition; one course in the classical or biblical backgrounds of British and American literature; three courses selected from the British and American literature period sequences, 360-362, 373-377; four courses selected from the Critical Approaches to Literature sequence, 450 A-F (with certain permissible substitutions); a distribution of literature courses to insure some acquaintance with both British and American literature and with both earlier and later literature. Two college years, or the equivalent, of a single foreign language are also required; courses taken to fulfill this requirement are usually applied in the Communications Group (Group 2). Supporting work is encouraged in such fields as linguistics, history, philosophy, psychology, speech, music, sociology, and anthropology. Details of these requirements are available from departmental advisers.

Graduate Study

The department offers work for the degree Master of Arts with major in English and minor work for students majoring in other departments. The master's degree ordinarily requires a thesis (6 credits), though in some instances nonthesis programs are approved. Courses must include 530; 511 or 512; and usually 503. A reading knowledge of one foreign language is required, to be demonstrated by test or by undergraduate course work. Near the end of the program, each candidate will be examined, in writing, on several writers and literary periods agreed upon by the candidate and the examination committee.

Prerequisite to major graduate work is the completion of study substantially equivalent to the undergraduate major program in English at Iowa State.

Programs are designed to prepare students for: (1) teaching at the secondary, community college, or beginning university level; (2) further graduate study in language and literature; (3) imaginative writing, scientific and technical writing, and editing.

In addition to the usual areas of study in literature and language, these special emphases are provided: (1) scientific and technical writing; (2) study of the relations between science and imaginative literature, and criticism; (3) rhetorical, linguistic, and semantic analysis of factual and imaginative writing, and of literary criticism.

Open to graduate students for minor graduate credit only: 315, 363, 365B, 368, 392A, 392B, 394, 414, 419, 420, 450, 464B, 473, 474, 495.

Courses Primarily for Undergraduate Students

10A, 10B, 10C. English for Foreign Students. 10A: (8-9); 10B: (4-1); 10C: (3-0). 10A: F.S.; 10B: F.W.; 10C: W.S. Prerequisite: Recommendation of English Department. Placement in the various classes is determined by examination. 10A: Level I English for foreign students. Emphasis on the spoken language with a general review of English grammar. Laboratory work in aural comprehension and pronunciation. 10B: Level II English for foreign students. Continued laboratory work in aural comprehension. More advanced grammar with some written composition, development of reading facility, and speaking practice. 10C: Level III English for foreign students. Advanced grammar, composition, and reading. For undergraduates: preparation for English 104-105. For graduates: satisfaction of requirements in English for the Graduate College.
104, 105. Language in Composition and Reading. (4-0) Cr. 4 each. F.W.S.SSI. Prerequisite: 105: 104. The role of language in human thought. Applications to reading and writing. Writing as communication of developed judgment or observation. Readings in expository and imaginative literature. Emphasis on reading and observation as sources of information, ideas, and values.

131, 132. Principles of Composition. (3-0) 131: Cr. 5. F.; 132: Cr. 5. W. Prerequisite: Selection of students solely by Department of English, on the basis of high school preparation and competence displayed in examinations. Application of principles governing the use of language in writing and reading. A course designed for especially advanced students as an alternate to 104, 105. Satisfies 104, 105 requirement in all curricula.

200. Developmental Reading. (0-2) Cr. 1 each time taken, maximum 9 credits. F.W.S. SSI. 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. Satisfactory-failure basis only.

201. Introduction to Literature. (3-0 or 4-0) Cr. 3 or 4. F.W.S.SSI. Prerequisite: Credit or classification in 105. Introduction to the forms and periods of imaginative literature. Emphasis on comprehension of both older and more recent literature in its relation to recurrent human problems. Students may select from sections (3 cr. each) devoted to 1805-1900, poetry, drama, fiction, several genres. Certain sections (4 cr. each) devoted to poetry, are designed especially for, though not limited to, English majors.

204. Intermediate Composition. (3-0) Cr. 3. F.W.S. Prerequisite: 105. Expository writing: practice in writing and criticizing concepts. Emphasis of grammar and rhetoric where pertinent to analysis of writing.

205. Propaganda Analysis: Reasoning and Writing. (3-0) Cr. 3. F.W.S.SSI. Prerequisite: 105. Study of the language in which current issues are presented to the public, especially language in mass media and thinking; application of basic rules of thinking to issues studied; practice in informative and persuasive writing; reading and discussion.

219. Introduction to English Linguistics. (3-0) Cr. 3. F.S.SSI. Prerequisite: 105 or 132. Kinds of grammars; relationship of written to spoken English; language change and stabilization; meaning and vocabulary; problems of authority and standards of usage; survey of the subdisciplines of linguistics.


304A, 304B. Advanced Composition. (3-0) Cr. 3 each. F.W.S. Prerequisite: 105; junior classification, permission of instructor. 304A: Descriptive and narrative techniques; emphasis on characterization and the short story. Writing, reading, criticism. 304B: Personalized exposition; personal, social, or scientific material with individualized expression.

306A, 306B. Advanced Composition. Cr. 3 each time taken, but not normally repeated. F.W.S. Prerequisite: 304A or 304B, permission of instructor. 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. Techniques of writing for television, film, and radio. Selected scripts used in broadcasts on WOI.

330. Modern Literature. (3-0) Cr. 3. W.S.SSI. Prerequisite: 201. Reading, interpretation, and evaluation of prose, fiction, drama, and poetry of representative American and British authors of the twentieth century.

344. Readings in Biography. (3-0) Cr. 3. S. Prerequisite: 105. Selections from biography and autobiography of great creative workers in science, engineering, agriculture, the arts, government. Other eminent contributors to civilization. Special attention to lives of scientists and to procedures of science. Impact of great men upon their own and later times.

354A, 354B. World Literature. (3-0) Cr. 3 each. 354A: W.S.SSI.; 354B: S.SSI. Prerequisite: 201. 354A: Ancient classics to Renaissance: Greek and Roman literature; European literature of the Middle Ages. 354B: European literature, Renaissance to 1850. Selected European literature from early Renaissance to modern times.

356. Literature of the Bible. (3-0) Cr. 3. S. Prerequisite: 201. Selected literature from Old Testament, New Testament, and apocrypha including narrative, poetry, wisdom literature, and apocalyptic literature.

360. American Literature to the Mid-Nineteenth Century. (3-1) Cr. 4. F.W.Alt. SSI., offered 1974. Prerequisite: 201. Selected American masterpieces from about 1850 to turn of the century; their literary value and their cultural sources and consequences. American literature from its beginnings as a minor branch of English literature to its achievement of international significance in the 1850's.

361. American Literature of the Later Nineteenth Century. (3-1) Cr. 4. W.S. Alt. SSI., offered 1975. Prerequisite: 201. Selected American masterpieces from about 1850 to turn of the century; their literary value and importance in American culture. Literature from the Eastern Seaboard flowering of the 1850's to development of a national culture.

362. American Literature of the Early Twentieth Century. (3-1) Cr. 4. F.S.Alt.SSI. Prerequisite: 201. Selected American masterpieces from turn of the century to about 1930; their literary value and importance in American culture. Development of the culture from which comes the literature of our own times.


365A, 365B. Afro-American Literature. 365A: (3-1) Cr. 4. W.; 365B: (3-0) Cr. 3. S. Prerequisite: 366A; 201 or junior classification; 365B: Survey of Afro-American literature. Literature by Black Americans from the beginnings to the mid-1960's, considered against the intellectual and social framework of American life and letters. 365B: Intensive reading of contemporary Afro-American literature. Literature by Black American writers of the 1960's and 1970's.

366. European Drama: The Greeks to Ibsen. (3-0) Cr. 3. W. Prerequisite: 201. Aeschylus to Ibsen, exclusive of British drama.

367. European and American Drama Since Ibsen. (3-0) Cr. 3. S. Prerequisite: 201. Significant trends in drama from Ibsen through World War II.

368. British Drama to 1642 Exclusive of Shakespeare. (3-0) Cr. 3. Alt. W., offered 1974. Prerequisite: 201. Medieval, Elizabethan, and Jacobean drama; reading, discussion, and criticism of representative plays.

373. English Literature of the Middle Ages. (3-1) Cr. 4. F.S. Alt. SSI., offered 1975. Prerequisite: 201. Introduction to medieval literature (Beowulf to Malory), with emphasis on six to eight writers, considered in the social and intellectual context of the period.

374. English Literature of the Renaissance. (3-1) Cr. 4. W. Alt. SSI., offered 1975. Prerequisite: 201. Introduction to Renaissance literature (More to Milton), with emphasis on six to eight writers, considered in the social and intellectual context of the period.

375. English Literature of the Restoration and Eighteenth Century. (3-1) Cr. 4. S. Alt. SSI., offered 1975. Prerequisite: 201. Introduction to Restoration and eighteenth-century literature (Dryden to Johnson), with emphasis on six to eight writers, considered in the social and intellectual context of the period.
ENGLISH 201

376. English Literature of the Romantic Period. (3-1) Cr. 4. F. Alt. SSL, offered 1974. Prerequisite: 20L. Instruction to Romantic literature (Blake to Byron), with emphasis on six to eight writers, considered in the social and intellectual context of the period.

377. English Literature of the Victorian Period. (3-1) Cr. 4. W. Alt. SSL, offered 1974. Prerequisite: 20L. Introduction to Victorian literature (Carlyle to Hardy), with emphasis on six to eight writers, considered in the social and intellectual context of the period.


388. Modern Poetsy. (3-0) Cr. 3. F. Prerequisite: 20L. 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.


394. Literature of Adolescence. (3-0) Cr. 3. S. Prerequisite: 20L. Literature both for and about the adolescent. Examination of reading programs and approaches to literature for the adolescent; critical study of genres, modes, and themes found in the literature, including a study of their function in children’s and adult literature.

414. Writing of Reports and Technical Papers. (3-0) Cr. 3. F.W.S.SL. Prerequisite: 105, junior classification. Technical, research, and business report writing. Principles of technical composition. Writing of reports, including one major report, preferably on topics from the student’s own discipline. (For advanced projects see English 507.)

418. Analysis of English Syntax. (3-0) Cr. 3. F.W.S.SI. Prerequisite: 21B. Theories and methods for analysis of English syntax, including transformational grammar.

420. History and Development of the English Language. (3-0) Cr. 3. S. Prerequisite: 105, junior classification. Background and development of the English language; its relationships with other languages of the past and present; linguistic change, current developments in English vocabulary, structure, and dialects.

450. Critical Approaches to Literature. (3-0) Cr. 3 each time taken. Maximum of six credits in each subsection. F.W.S. Prerequisite: 201. Major critical and conceptual approaches to literature, illustrated by application to selected writers and literary works.

A. History of Criticism (recommended: 354A, 484A);
B. Literary Theory;
C. Genre; Mode;
D. Theme;
E. Comparative Figures;
F. Period; Movement.

464A, 464B. Shakespeare. (3-0) Cr. 3 each. 464A: F.S.; 464B: W. Prerequisite: 464A: 20L; 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.

473. Chaucer. (3-0) Cr. 3. Alt. W., offered 1975. Prerequisite: 375. Reading of The Canterbury Tales in Middle English.


489. Undergraduate Seminar. (3-0) Cr. 1 to 3 each time taken, maximum of 6 credits. F.W.S. Prerequisite: Twelve credits in English beyond 105. Intensive study of a selected topic in literature, criticism, or language.

490. Special Problems in English. Cr. var. Prerequisite: Nine credits in English beyond 105, junior classification, permission of department chairman. Designed to meet the needs of students who seek work in areas other than those in which courses are offered, or who desire to integrate a study of literature or language with special problems in major fields.

A. Literature.
B. Linguistics; Semantics.
C. Rhematics; Teaching of composition.
D. Criticism and theory of literature.
E. Honors.

494. The Teaching of English. (4-0) Cr. W.S. Prerequisite: Admission to teacher education program, Educ 305, and 45 credits in English beyond 105. Materials and methods of English instruction in the secondary schools, grades 7-12; preparation for student teaching.

495. Teaching English to Speakers of Other Languages. (3-0) Cr. 3. W. Prerequisite: 21B. Methods and materials for teaching English as a second or foreign language, or as a standard dialect for the disadvantaged. Familiarity with linguistic terminology is useful, but not required.

496. The Teaching of Composition. (4-1) Cr. 3. F. Prerequisite: 494. Current communication theory with applications. Classroom practices, evaluation of writing, and definition of standards. Junior high school and high school writing programs.

497. Supervised Tutoring. (1-1) Cr. 1 or 2 each time taken; maximum of 3 credits. F.W.S.SS. Prerequisite: Fifteen credits in English beyond 105, permission of instructor. Priority given to students in teacher education programs. Practical experience in developing methods for teaching English in a tutorial situation. Assignment to a series of private tutoring sessions with a student who has requested or shown need for special help in English. Observation, conferences, and seminar meetings with staff supervisor. Satisfactory-fail basis only.

Courses Primarily for Graduate Students, major or minor, open to qualified undergraduates.

503. Problems in Written Communication. (3-0) Cr. 3. W.S.SSl. Prerequisite: Permission of instructor. For secondary, junior college, or college teachers. Current communication theory with applications. Evaluation of writing and definition of standards. Secondary and college writing programs.

504. Advanced Imaginative Writing. Cr. 1 to 3 each time taken, maximum of 9. F.W.S.SSl. Prerequisite: 504A or 504B, permission of instructor; one quarter before course begins. Individual projects.

507. Scientific and Technical Writing. Cr. 1 to 3 each time taken, maximum of 6. F.W.S.SSl. Prerequisite: Permission of instructor one quarter before course begins. Technical language and style. Analysis and writing of scientific prose, including abstracts, manuals, proposals, and other technical papers. Individual projects. Directed readings.


512. Problems in the History of the English Language. (3-0) Cr. 3. 8. Alt. SSL, offered 1974. Prerequisite: Permission of instructor. Historical linguistics; application to selected problems in the development of the English language.
552. Theory of Literature. (3-0) Cr. 3. Alt. SSI., offered 1975. Prerequisite: Nine credits in literature beyond 201. Application of critical principles to literary problems and controversies. Clarification of terminology; examination of critical generalizations and assumptions.


550. Bibliography and Research Methods. (3-0) Cr. 3. F.SSI. Prerequisite: Eighteen credits in literature. Required of candidates for the master's degree.


554. Science and Literary Imagination. (3-0) Cr. 2 each time taken, maximum of 5. F. Alt. P.W., offered 1973-74. Prerequisite: Nine credits in British or American literature. Imaginative literature and criticism from a selected historical period, considered with reference to concurrent developments in science. Emphasis on literary world picture, metaphor, and language theory.

562. American Transcendentalist Writers. (3-0) Cr. 3. S. Alt. SSI., offered 1976. Prerequisite: Nine credits in American literature including 360. 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.


566. Major American Poets. (3-0) Cr. 3 each time taken, maximum of 6. W. Alt. SSI., offered 1975. Prerequisite: Nine credits in American literature including 361. Major American poets from Edward Taylor through Eliot and Frost, but with particular emphasis on such nineteenth century figures as Bryant, Emerson, Whitman, Dickinson, and Melville.

570. English Poetry of the Seventeenth Century. (3-0) Cr. 3. Alt. W. and SSI., offered 1975. Prerequisite: Nine credits in English literature including 374 or 375. Development of English poetry from Donne to Dryden. Concentration on a few selected authors, excluding Milton.


573. English Literature of the Sixteenth Century. (3-0) Cr. 3. Alt. F., offered 1974; Alt. SSI., offered 1975. Prerequisite: Nine credits in English literature including 374. Poetry and prose of late fifteenth and sixteenth centuries.

574. Chaucer. (3-0) Cr. 3. F. Alt. SSI., offered 1974. Prerequisite: Nine credits in English literature including 373. Intensive study of selected Canterbury Tales and minor poems. Introduction to Chaucer scholarship.

575. Milton. (3-0) Cr. 3. S. Alt. SSI., offered 1974. Prerequisite: Nine credits in English literature including 374. Paradise Lost, with other poems and selections from the prose.


577. Victorian Writers. (3-0) Cr. 3 each time taken, maximum of 6. Alt. W., offered 1975; Alt. SSI., offered 1974. Prerequisite: Nine credits in English literature including 377. Selected Victorian and Edwardian authors.

579. British Drama, 1660-1714. (3-0) Cr. 3. Alt. W., offered 1975; Alt. SSI., offered 1974. Prerequisite: Nine credits in English literature including 375. Restoration and eighteenth century comedy, and heroic tragedy, as seen in the plays of Dryden, Wycherley, Congreve, and minor dramatists.

580. Shakespeare. (3-0) Cr. 3. Alt. SSI. Prerequisite: Nine credits in English literature including 464B. Shakespeare as poet and dramatist. Chief critical schools and areas of scholarship.

589. Seminar. Cr. var. F. W. SSI. Prerequisite: Permission of instructor.

590. Special Topics. Cr. var. Prerequisite: Permission of department chairman.

599. Graduate Seminar. Cr. var. F.W.S.SSI. Prerequisite: Eighteen graduate credits, permission of department chairman.

Courses for Graduate Students, major or minor

577. Victorian Writers. (3-0) Cr. 3 each time taken, maximum of 6. Alt. W., offered 1975; Alt. SSI., offered 1974. Prerequisite: Nine credits in English literature including 377. Selected Victorian and Edwardian authors.

579. British Drama, 1660-1714. (3-0) Cr. 3. Alt. W., offered 1975; Alt. SSI., offered 1974. Prerequisite: Nine credits in English literature including 375. Restoration and eighteenth century comedy, and heroic tragedy, as seen in the plays of Dryden, Wycherley, Congreve, and minor dramatists.

580. Shakespeare. (3-0) Cr. 3. Alt. SSI. Prerequisite: Nine credits in English literature including 464B. Shakespeare as poet and dramatist. Chief critical schools and areas of scholarship.

589. Seminar. Cr. var. F. W. SSI. Prerequisite: Permission of instructor.

590. Special Topics. Cr. var. Prerequisite: Permission of department chairman.

599. Graduate Seminar. Cr. var. F.W.S.SSI. Prerequisite: Eighteen graduate credits, permission of department chairman.

A. Literature; Criticism.
B. Linguistics; Semantics.
C. Rhetorical analysis; Communication.

Entomology

For description of courses, see Zoology and Entomology.

Family Environment

Ronald C. Powers, Head of Department

Professors: Beveridge, Budolfson, Liston, Peet, Pickett.
Associate Professors: Schwieder, Shank, Wells.
Assistant Professors: Heitsley, Hull, Meredith, Peterson, Weltha.
Instructors: deBaca, Eldridge, Foell, Leichsenring, Martin, Norem, Wedin, Yerans.
Undergraduate Study

For undergraduate curriculum in family environment leading to the degree of Bachelor of Science, see Home Economics, Curricula.

The department offers work for the degree Bachelor of Science with three options: (1) family services, (2) consumer services, and (3) general education.

The Department of Family Environment offers courses designed to develop an understanding of the family as and in environment. All of the options include coursework which emphasizes the family, its near environment, and the interaction of the family with its environment.

The family services option prepares students for a wide range of employment. Opportunities may be found with public and private family service agencies, public housing, youth groups, and home economics extension.

The consumer services option prepares students for employment with agencies and organizations focusing on housing, equipment and management, and consumer behavior. The agencies and organizations may be business and industry, government agencies and private nonprofit organizations.

The general education option is nonprofessionally oriented. Courses are selected from several areas and may provide excellent preparation for family life and community volunteer opportunities.

The subject matter areas within the department may be combined in several ways within each option depending on the specificity of the students' educational objectives. The four subject matter areas are: consumer and management, household equipment, housing, and individual and family.

Graduate Study

The department offers work for the degree Master of Science with major in family environment and minor work for students taking major work in other departments. Work may be taken for the degree Doctor of Philosophy as a joint major with departments such as Home Economics Education, Child Development, Food and Nutrition, Economics, Physics, Chemistry, and Sociology and Anthropology. The department cooperates in the housing and water resources programs. (See Housing, Water Resources.)

Prerequisite to major work in family environment is the completion of at least 15 credits in each of the following areas: communicative arts, humanities, physical and biological sciences, and social and behavioral sciences. The student should also have the equivalent of the courses generally considered as introductory principles in the family environment program at this institution. Students emphasizing the physical aspects of family environment should have the basic work in equipment and food preparation. Educational background in the biological, chemical, physical, or social sciences may be suitable, depending on the student's objectives.

Courses Primarily for Undergraduate Students

185. Families and Their Environment. (3-0) Cr. 3. F.W. Exploration of the social, economic, physical, and aesthetic dimensions of family environment.

240. Introduction to Family Housing. (3-0) Cr. 3. F.W.S. Criteria for evaluating aspects of family housing environment in the United States. Factors related to differences in family needs. Problems and programs for housing improvement.

254. Equipment in the Home. (3-0) Cr. 3. F.W.S. Utilization of water, electricity, gas, light, and heat for doing work and maintaining health and comfort in the home environment. Application of basic physical science principles.

270. The Individual and His Family. (3-0) Cr. 3. F.W.S. Prerequisites: Three credits of psychology, Soc 134. Basic need fulfillment throughout the life cycle. Developing individual potential as a member of a family through experiences of love, trust, identity, responsibility, and autonomy. Satisfactory-fail only.

285. Family Needs and Services in American Culture. (3-0) Cr. 3. F.W.S. Prerequisite: Three credits of psychology, Soc 134. Examination of needs and services within stages of family development and among families of different socioeconomic levels. Particular emphasis upon the evolution of familial needs and services.

308. Modern Lighting for Residential Interiors. (2-4) Cr. 3. F.W.S. Prerequisite: Three credits in housing and equipment, and permission of instructor. Lighting as a design factor to meet needs of individuals and families for task, general, and decorative purposes. Light sources and techniques to implement objectives in design.

318. Small Equipment. (2-4) Cr. 3. F.W.S. Prerequisite: Sophomore classification. Selection and use of portable appliances as related to various consumer needs and interests. Laboratory experiences with appliances for food preparation, care of the home, clothing construction, personal grooming.

340. Housing for Special Groups. (3-0) Cr. 3. S. Prerequisite: 240. The housing problems of the low-income, minority, and physically limited segments of our society. Programs and research currently being conducted or proposed toward solution of the housing problems of these groups.

341. Housing Finance. (3-0) Cr. 3. S. Prerequisite: 240. Econ 241 or 242. Financial consideration needed when individuals and families rent, remodel, buy, or build dwellings.

375. Management in the Family. (3-0) Cr. 3. F.W.S. Prerequisite: Three credits of psychology, Soc 134. Econ 241 or 242. Management related to functions of the family in society. Comparison of families with respect to goals sought, resources available, and managerial behavior. Changes within the family and its environment which necessitate management. Decision and choice as aspects of individual and group adjustment to changed situations.

385. Family Life Patterns. (3-0) Cr. 3. F.W.S. Prerequisite: Three credits of psychology, Soc 134. Standards and levels of living and life styles. Relationship of environmental conditions to family life patterns.

386. Family Services. (3-0) Cr. 3. W. Prerequisite: 285. An examination of organizations and agencies serving families. Emphasis on purposes, staffing, operation, and

FAMILY ENVIRONMENT 203
COURSES AND PROGRAMS

408A, 408B. Equipment for Care of Modern Fabrics. 408A: (3-0) Cr. 3. S. 408B: (0-3) Cr. 1. S. Prerequisite: T & C 204. 408A: Survey of equipment, materials, and procedures designed for modern fabric care. Relationship of performance to methods of care. Review of research and current literature. 408B: Laboratory experimentation. Concurrent registration in 408A is required.

410. Food-Related Major Home Appliances. (3-3) Cr. 4. W. Prerequisite: 254, F & N 208. Design and performance of ranges, refrigerators, and food freezers. Use and evaluation in terms of utility to consumers.

412. Kitchen, Bath, and Utility Area Planning. (2-4) Cr. 3. W. Prerequisite: Six credits in housing, applied art or architecture, junior classification. Planning of kitchen, bath, and utility areas for form, function, and economy; problems of effective use of utilities; remodeling.

415. Families as Consumers. (3-0) Cr. 3. F.S. Prerequisite: Three credits of psychology, Soc 134, Econ 241 or 242. The family's relationship to the consumer movement; consumer issues; dimensions of the consumer role; interaction of consumer, government and the market; process of choice; evaluation of information and protection.

421. Demonstration. (2-4) Cr. 3. S. Prerequisite: 254, Sp 211, senior classification. Demonstration as a means of integrating and communicating knowledge. Planning and presenting direct audience demonstrations for groups of varying size, background, and interest. Reservations required.

425. Seminar. (1-0) Cr. 1. F.W.S. Prerequisite: Junior classification.


446. Housing Alternatives for Individuals and Families. (2-3) Cr. 3. F. Prerequisite: 240. Meeting human needs through alternative housing forms. Emphasis on internal housing environment as influenced by technological and physical factors.

490. Rehabilitation Principles and Services. (2-0) Cr. 2. F.S. Prerequisite: Junior classification. Programs and activities designed for individuals or a disabled or handicapped family member to functioning in his home and community. Presentations by rehabilitation team members with whom home economists work. Physical, social, psychological, economic, and intellectual limitations of individuals.

470. Communication With Families. (3-0) Cr. 3. F.W. Prerequisite: 270, 395. Principles of communicating with families of different socioeconomic levels. Exploration of the role of empathy and sensitivity in establishing helping relationships with families.

485. Planning Change in the Family Environment. (3-0) Cr. 3. S. Prerequisite: Nine credits in sociology, psychology, urban planning or family environment; junior classification. Methods of identifying and analyzing problems in the environment of families. Techniques of involving families in effective processes of planning change.

488. Family Finance. (3-0) Cr. 3. F.W.S.SS. Prerequisite: Three credits of psychology, Soc 134, Econ 241 or 242. Managerial approaches to financial problems of families through relating relative to acquiring and affording income. Financial management focused on consumer, credit, savings and investment, insurance, home ownership, and estate planning.

489. Managerial Resources and Processes in Family Life. (2-3) Cr. 3. F.W.S. Prerequisite: 375. Processes involved in management of family resources of human capital, property, financial resources, as well as money, time, space, and natural environment.

490. Special Problems. Cr. arr. Prerequisite: Twelve credits in applicable courses and permission of instructor. Consult department office for procedures for filing a written plan of study.

Courses Primarily for Graduate Students, major or minor, open to qualified undergraduates

500. Family Environment Short Courses. Cr. arr. SS. Short courses designed primarily for special groups. Credits are not accepted for graduate credit in family environment. Short courses are offered under the following general designations.

A. Family Relations and Human Development.
B. Housing.
C. Consumer Economics and Management.
D. Household Equipment.
E. Field Trips and Field Experience.
F. General Family Environment.
H. Honors Programs.

491. Practicum. Cr. var., 16 hr. maximum. Satisfactory-fail only. Prerequisite: Permission of instructor. Supervised work experience off-campus in the following service areas.

A. Helping Services.
B. Consumer Services.

A. Family Relations and Human Development.
B. Housing.
C. Consumer Economics and Management.
D. Household Equipment.
E. Field Trips and Field Experience.
F. General Family Environment.
H. Honors Programs.

504. Research Methods and Techniques. (2-4) Cr. 4. F. Research methods and techniques applicable to studies of the family as and in environment. Emphasis on research design and problem selection.

519. Consumer Dynamics. (3-0) Cr. 3. S. Prerequisite: 416, 488. Consumer roles in the evolution of economic society. Analysis of changes in consumer interactions with public and private institutions serving consumer interests.

521. Housing and Social Environment. (3-0) Cr. 3. W. Prerequisite: 240 or equivalent, Econ 241 or 242, three credits of psychology, Soc 134. Human housing as related to social environments: political, economic and sociological. Management of housing for human development. Emphasis on research.

522. Time and Human Resources. (3-0) Cr. 3. W. Prerequisite: Soc 134, 3 credits in psychology, Econ 241 or 242. Time, space, and human attributes as basic resources in family life. Social and technical concepts for furthering attainment of family goals through work and leisure.

523. Management Within Family Environment. (3-0) Cr. 3. S. Prerequisite: 378. Philosophy and trends of management in the family related to environmental conditions and socioeconomic levels.

540. Advanced Studies in Household Equipment. (2-3) Cr. 3. each time elected. Alt. F., offered 1973. Prerequisite: 504, 12 credits of household equipment. Experimental study of appliances designed for automating tasks related to food storage, preparation, and cooking; care and construction of modern fabrics; and maintenance of health, comfort, and convenience in the home. Planning and conducting performance tests for studying suitability of appliances for performing intended service to families.

570. The Individual and Family Development. (3-0) Cr. 3. F.W.S.S. Prerequisite: Twelve credits in behavioral sciences. Experiential learning and encounter with ways that interpersonal relationships contribute to the development of human potential for individuals and families.

575. Cultural Foundations of Family Life. (3-0) Cr. 3. S. Prerequisite: Nine credits in behavioral sciences. Cultural influences in individual and family development; roles of family members; values, customs, taboos, and rituals related to family life.

578. Family Analysis. (3-0) Cr. 3. W. Prerequisite: Nine credits in behavioral sciences. Analysis of conceptual frameworks in the area of the family by examining their de-
development, concepts, assumptions, inadequacies, and contradictions.

579. Dynamics of Family Relationships. (3-0) Cr. 3. S. Prerequisite: Nine credits in behavioral sciences. Psychological analysis of interpersonal relationships within the family as influenced by basic needs, familial roles, and values and attitudes in a changing society.

580. Family Economics. (3-0) Cr. 3. F. Prerequisite: Econ 241 or 242, 3 credits in psychology, Soc 134. Problems of measuring family income, wealth, and welfare. Programs for improving adequacy and security of income during family life cycle. Factors which influence standards and levels of living.

590. Special Topics. Cr. arr. Prerequisite: Permission of instructor. Consult department office on procedure for filing a written plan of study.
A. Family Relations and Human Development.
B. Housing.
C. Consumer Economics and Management.
D. Household Equipment.
E. Field Trips and Field Experience.
F. General Family Environment.

591. Practicum in Family Environment. (as arr.) Cr. 1 to 6 each time elected. Prerequisite: Completion of 15 credits of graduate coursework. Supervised experience in the following areas of family environment.
A. Family Relations and Human Development.
B. Housing.
C. Consumer Economics and Management.
D. Household Equipment.
G. General Family Environment.

Courses for Graduate Students, major or minor

604. Seminar. Cr. 1 to 3. F.W.S.
A. Family Relations and Human Development.
B. Housing.
C. Consumer Economics and Management.
D. Household Equipment.
G. General Family Environment.

698. Research. Cr. arr.
A. Family Relations and Human Development.
B. Housing.
C. Consumer Economics and Management.
D. Household Equipment.
G. General Family Environment.

Food and Nutrition

Wilma D. Brewer, Head of Department

Instructors: Bohnenkamp, Corey, Madden, Olsen, Smith, Stang, Stecker.

Undergraduate Study

Courses in food and nutrition acquaint the student with the principles underlying the selection, preparation, and use of food for human health and for the welfare of society. Emphasis is placed on the scientific, cultural, and professional aspects of the broad area of food and nutrition.

The department offers work for the degree Bachelor of Science with four majors: community nutrition, dietetics, food and nutrition and related science, and food science. Each of these majors affords excellent preparation for many different kinds of positions and provides a good basis for graduate study for students who wish to continue for advanced degrees.

The major in community nutrition offers preparation for work as a nutrition consultant in public health, social welfare organizations, extension service, or industry. This major is planned for students interested in helping people everywhere to use knowledge of nutrition for the betterment of their health.

The major in dietetics is planned for students interested in foodservice and nutrition education. Graduates are prepared for a wide variety of positions in hospitals, clinics, sanatoriums, and homes for children and for the aged. They may work as private nutrition consultants in cooperation with physicians, or as nutritionists with food industries. This major meets the academic requirements of the American Dietetic Association.

The major in food science and related science prepares students for positions as research assistants in laboratories of colleges and universities, research institutes, government agencies, industries, and foundations. It affords an especially strong background for graduate work.

The major in food science serves those who are interested in preparation of food and in food-product development in experimental kitchens or laboratories of industries or universities. It prepares students for food-product development or food-promotion programs in industries, for food editorships in papers and magazines, and for conducting food-centered programs on radio and television. It leads to careers in consumer services in business and industry.

Graduate Study

The department offers work for the degree Master of Science with majors in food science, nutrition,
and food and nutrition, and for the degree Doctor of Philosophy with majors in food science and 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 from other fields of home economics as well as from chemistry, biochemistry, bacteriology, economics, food technology, journalism, psychology, physiology, statistics or other related fields. There is no foreign language requirement for the degree Master of Science. For the degree Doctor of Philosophy, the foreign language requirement may be met by: (1) demonstration of a satisfactory reading knowledge of two languages (French, German, Spanish, Russian); (2) competence in communication in one of the above languages as demonstrated by examination or as indicated by two years of course work (C grade or better) in the baccalaureate program.

Open to graduate students for minor only: 305, 410 413, 414, 419, 431, 432, 433.

Courses Primarily for Undergraduate Students

107. Nutrition and the Family’s Food. (4-0) Cr. 4. F.W.S.SS. Prerequisite: Biol 101A or 101, 102B or Zool 155. The selection and use of food for health and satisfaction of the individual and the family.

201. Orientation to Food and Nutrition. (1-0) Cr. 1. F.S. Prerequisite: Freshman or sophomore classification. Scope and significance of food and nutrition; professional opportunities.

208. Principles of Food Preparation. (3-6) Cr. 5. F.W.S. Prerequisite: Credit or classification in Chem 231 or 334 and F & N 107 or 232. 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; Chem 231 or 334, credit or classification in F & N 107; 215: 214. Composition and structure of foods and principles underlying preparation of food products of standard quality; behavior and interactions of constituents of food. This sequence is prerequisite for advanced study of food.

232. Nutrition of the Child and the Family. (3-0) Cr. 3. F.W.S. Prerequisite: Biol 101A or 101, 102B or Zool 155. Nutritional needs during reproduction, growth, and later life; adjusting meals to meet the needs of family members. Not available to students with credit in 107, 305 or 410.

303. Family Meal Management. (3-3) Cr. 4. F.W.S.S.S. Prerequisite: 107 or 305; 208 or 215. Thompson. Choice, purchase, preparation, and service of foods; a study of foods on the market; time, energy, and money management in relation to feeding the family; consideration of nutritional needs, food habits, and social customs of family groups.

304. Sensory Evaluation of Food. (1-4) Cr. 3. Alt. S. Prerequisite: 208 or 215 or F Tch 114. Application of principles of sensory evaluation of the quality of foods.

Methodology for taste panels. Correlation of data with objective measurements of food quality.

305. Nutrition and Dietetics. (3-3) Cr. 4. F.W.S. Prerequisite: 3 credits in biochemistry; Biol 101A or 101, 102B or Zool 155; junior classification. Physiological and chemical bases for nutrient needs; factors to consider in satisfying these needs for individuals and populations.

320. Fundamentals of Food Measurements. (1-6) Cr. 3. S. Prerequisite: Math 108 or 111. Advance requirements recommended. Miller. Basic concepts and principles of the assessment of foods; introductory aspects of subjective and objective evaluation of food quality. Certain basic influences in food acceptance patterns.

400. Field Study Tour. Cr. R; F.S. Prerequisite: A: Credit or classification in 405; B: Senior classification, permission of instructor. A: Observation of the dietitian in a medical teaching center, hospital, clinic, and public health department. B: Guided study tour of industrial food centers, food research laboratories, and experimental test kitchens.

404. Seminar in Food and Nutrition. (2-0) Cr. 2. F.W. Prerequisite: 305, senior classification. Major's only. Brewer. Orientation to professional work; state, national, and international problems in food and nutrition.

410. Nutrition During Human Growth and Development. (2-2) Cr. 3. F.S. Prerequisite: 305. Nutritional needs during growth and reproduction; problems in feeding infants, children, and women during the reproductive period; indices of growth and development.

411. Experimental Studies of Food. (2-6) Cr. 4. F.W. Prerequisite: 215, 3 credits in biochemistry, senior classification. Miller. Application of scientific principles to the solution of problems in food preparation. Not to be taken by majors in food science or students desiring to take 421 and 422.

413. Community Nutrition. (3-3) Cr. 3. F.S. Prerequisite: 305. Survey of current public health nutrition problems; food misinformation; food habits of population groups which have a high incidence of malnutrition; discussion of community programs designed to help solve problems. Field trips in conjunction with programs of Iowa State Department of Health or Cooperative Extension Service.

414. Seminar in Community Nutrition. (2-4) Cr. 2. S. Prerequisite: 413. Methods used in making dietary studies and judging apparent nutritional status; use of findings in planning community nutrition programs.

415. Introduction to Nutrition Research. (0-9) Cr. 3. F.W.S. Prerequisite: 305, B & B 305; Chem 211 or B & 311; classification of instructor. Introduction to methods used in nutrition research with application to selected problems.

418. Methods of Teaching Nutrition. (3-0) Cr. 3. W.S. Prerequisite: 431, Psych 333. Objectives, organization of subject matter, practical application of methods and techniques for teaching patients, medical and dietetic interns, student nurses, and employees.

419. The Dynamics of the Family Food Economy. (3-0) Cr. 3. Alt. W., offered 1975. Prerequisite: Econ 242, junior or senior classification. The parameters of the family decision-making focused on food, trends in food marketing, fundamentals of the food market economy. Optimizing competence in the food market to achieve basic human needs and wants.

420. History of Food. (2-3) Cr. 3. F. Prerequisite: 320, 9 credits in social sciences. Miller. Study of our food heritage; historical perspectives as they influence and determine present-day foods of families.

421. Principles of Food Science I. (2-6) Cr. 4. F. Prerequisite: 320, B & 301, 311. Experimental approach to the study of factors influencing behavior of foods: eggs, emulsions, gels, batters, and meats.

422. Principles of Food Science II. (2-6) Cr. 4. W. Prerequisite: 421. Miller. Experimental approach to the study of doughs, fats and oils.
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. Seminar. Cr. R; F.W.S. Required of all graduate majors in the Food and Nutrition Department.

615. Advanced Nutrition. (3-0) Cr. 3 each time elected. F.S. Prerequisite: 601. Amrich, Kenney, Roderuck, Runyan. Series of one-term courses on such topics as proteins, vitamins, minerals, lipids, energy metabolism, evaluation of nutritional status. Classical and current research literature in each area.

619. Research Methods in Food Science. (1-6) Cr. 3 or 5 or W. Prerequisite: 521, Chem 335, Bact 413. Application of physical, chemical, and organoleptic techniques to research in food science. Use of experimental design, analysis of data and review of literature.

620. Advanced Food Science. (3-0 or 2) Cr. 3 or 4. Prerequisite: 618. Carlin. Physical and chemical behavior of basic food constituents. Series of one-semester courses on such topics as protein, fat, carbohydrate.


699. Research.
   A. Nutrition.
   B. Food Science.

Courses for Graduate Students, major or minor

601. Principles of Nutrition. (3-0) Cr. 3. W. Prerequisite: 305, B & B 305. Advanced study of nutrition. Required of all graduate students in the department.

606. Chemical Methods for Research in Food and Nutrition. (1-0) Cr. 4. F. Prerequisite: 305; Chem 211 or equivalent. Kenney. Application of chemical techniques to research in nutrition.

607A, 607B. Animal Experimentation in Nutrition Research. 607A: (1-0 or 3) Cr. 1 or 2. W.; 607B: (0-6) Cr. 2. S. Prerequisite: 606 or Chem 211 or equivalent. Amrich.

Food Technology

Verner H. Nielsen, Head of Department

Professors: Carlin, Goll, Hammond, Hartman, Iverson, Kline, Kraft, LaGrange, Marion, Reinbold, Snyder, Walker.

Associate Professors: Parrish, Rosenberger, Rust, Stromer, Topel, Wright.

Assistant Professors: Hasian.

Undergraduate Study

For undergraduate curriculum in Food Technology, see College of Agriculture, Curricula.

Food technology is a curriculum administered by the College of Agriculture. It consists of the application of the sciences (especially chemistry, microbiology, and engineering) to the development, manufacture, marketing, and protection of food products. The many facets of food technology, such as research, development, processing, packaging, quality control, marketing, foreign trade, and governmental supervision create a variety of interesting career opportunities. The curriculum is constructed according to the recommendations of professional societies. It has been made flexible so that a student after taking a core of basic courses in food processing, preservation, sanitation, and analysis may specialize in those fields of the food industry that are most attractive.
Business

Students who are particularly interested in purchasing and sales management, marketing, and the economic aspects of the food industry may elect the business minor, in which courses in industrial management, economics, and communications replace some of the courses in the physical and biological sciences.

Special Programs

Students who wish to combine education in mechanical, chemical, or agricultural engineering with that in food technology may arrange a special five-year program leading to Bachelor of Science degrees in food technology and that of the engineering department selected.

Minor work is available to students majoring in other curricula by selecting 15 credits (for second minor) or 20 credits (for first minor) of selected courses in food technology.

Graduate Study

The department offers work for the degrees Master of Science and Doctor of Philosophy with major in food technology, and minor work for students majoring in other departments. Graduate work in meat science is offered as a joint major in animal science and food technology. Within the food technology major, the student may specialize in bacteriology or dairy microbiology.

The department also participates in the interdepartmental programs of cell biology and water resources. (See Cell Biology and Water Resources.)

Prerequisite to major graduate work is the satisfactory completion of an undergraduate curriculum essentially equivalent to the food technology curriculum offered in this department or the completion of a curriculum in a related science such as dairy technology, bacteriology, chemistry, biochemistry, or engineering. Preparation in biology, chemistry, physics, and calculus along with knowledge of food processing, sanitation, and preservation are particularly desirable for those intending to pursue graduate work.

The foreign language requirement for the degree Master of Science is a reading knowledge of one foreign language, as evidenced by a score of 400 or more on the ETS examination. The foreign language requirement for the degree Doctor of Philosophy is a reading knowledge of one foreign language, as evidenced by a score of 500 or more on the ETS examination and by satisfactory completion of one year of college study in the same language. German, French, Russian, and Spanish are acceptable foreign languages. Other languages, including English for foreign students, may be acceptable based on the judgment of the student's graduate committee.

Courses open to graduate students for minor credit only: 398, 412, 414, 449, 450, 491, 492. Exceptions may be made for graduate majors whose undergraduate preparation was not in food or a food-product technology but in a related science. Upon approval of their graduate committees, they may take dairy and food industry courses with 400 numbers for graduate credit.

Courses Primarily for Undergraduate Students

All courses with numbers less than 500 are open to undergraduate students on a satisfactory-fail basis.

110. Technical Lectures. (1-0) Cr. R. F. Orientation in preparing for a career as food technologist.


202. Basic Food Industries. (3-0) Cr. 3. W. Prerequisite: 114 and permission of instructor. Manufacture of basic food products. Food packaging. Application of new processes to the food industry.

305. Processing and Marketing of Fluid Milk. (3-0 or 6) Cr. 3 or 5. Alt. F., offered 1974. Prerequisite: Chem 231 or 335. Biol 101A. Reinbold. The application of microbiology, chemistry, and technology to the processing and distribution of fluid milk products; sanitary standards; quality control.

398. Seminar on the World Food Problem. (2-0) Cr. 2. Prerequisite: 114 or 202. F. Kraft and Snyder. Study of the task of providing food for the world's population. Class discussions based on readings in population growth, food production, availability of plant and animal proteins, new foods, food supplements, nutrition, and barriers to agricultural development. Satisfactory-fail basis.

412. Food Preservation. (Bact 412) (3-0 or 6) Cr. 3 or 5. F. Prerequisite: Biol 101A. Kraft. Preservation, maintenance of quality of food products. Field trips.

414. Food, Milk and Water Sanitation. (Bact 414) (3-0 or 6) Cr. 3 or 5. S. Prerequisite: Biol 101A. Walker. Control of biological, chemical, and physical environments in microbiological processing. Sanitation and safety of foods and water. Regulations governing sanitation. Field trips.

449. Food Chemistry. (3-6) Cr. 3 or 5. F. Prerequisite: Chem 231 or 335. Hammond. The structure, properties, and reactions of important food constituents and basic food commodities. The analysis and composition of food products.


490. Special Problems in Dairy and Food Technology. (0-6 or 9) Cr. 2 or 3. Prerequisite: Junior classification, quality-point average of 2.5 or more for preceding two quarters. Laboratory investigations, assigned readings, and reports on chemical, microbiological, and processing problems of food products.

H. Honors Program.

491, 492. Introduction to Food Processing Systems. (3-0 or 3) Cr. 3 or 4. Alt. F. W., offered 1973. Prerequisite: 202, Math 109. 491: Processing of several food commodities will be used to illustrate food processing systems and unit operations. 492: Packaging, quality control, plant design and layout as applied to food processing.

499. Undergraduate Seminar in Food Technology. (1-0) Cr. 1. May be taken twice for credit. S. Prerequisite: Junior standing. Snyder.
Courses Primarily for Graduate Students, major or minor, open to qualified undergraduates

547. Food Technology. (2 or 3-0) Cr. 2 or 3. F.W.S. Prerequisite: Permission of instructor. Selected topics in food technology. Schedule of presentation will be announced.

548. Food Industry Regulations. (2-0) Cr. 2. Alt. S., offered 1974. Prerequisite: Permission of instructor. Hammond and Snyder. Study of international, federal, state and local regulations affecting food products development, manufacture, and marketing; standards and definitions; food safety and consumer protection.

Courses for Graduate Students, major or minor

623. Topics in Food Chemistry. (3-0) Cr. 3. Alt. W., offered 1974. Prerequisite: 449 or permission of instructor. Hammond and Snyder. The chemistry of processes leading to changes in flavor, texture, or color in foods.

640. Food Proteins. (3-0) Cr. 3. Alt. F., offered 1973. Prerequisite: B & B 404 or permission of instructor. Fundamental properties of protein systems found in milk, eggs, meat, and cereal grains. Effect of processing on food proteins.

660. Seminar. (1-0) Cr. 1. F.W.S.

670. Special Problems in Food Technology. Cr. arr. Prerequisite: A major or minor in food technology or dairy microbiology.

699. Research.

Foreign Languages

Walter D. Morris, Head of Department

Profeeors: McVicker, Schwartz, Soto.

Associate Professors: Bernard, Graupera, Judith Lacasa, Michelsons.

Assistant Professors: Bruner, Chatfield, Courteau, Dow, Kahn, Norman, Rumold, Sullivan, Thogmartin, von Wittich.


Undergraduate Study

Courses offered by the Foreign Language Department are designed to give students a knowledge of the fundamentals of the language, and of the culture and the literature of the people whose language is being studied.

The department offers majors in French, German, Russian, and Spanish, leading to the degree Bachelor of Arts. For a complete statement of degree requirements, see Sciences and Humanities, Curriculum.

Majors in the various languages are required to complete at least 57 hours, with 36 hours at the 300 level or above, with the possible inclusion of credits gained by examination, applicable to the major, limited to 21. The courses include sequences in civilization, composition, and conversation and literature.

Students who have had foreign language training in high school in a language offered at Iowa State may obtain credit by passing appropriate examinations. Native speakers of the foreign languages may take certain courses in their languages at the 300 level or above, or may obtain credit by passing appropriate examinations at that level.

Graduate Study

Courses open for graduate minor credit are: 407, 408, 409, 410, 411, 412, 413, 414, 415, 440, 441, 442, 443, 464, 465, 466, 473, 474, 475, 491, 492, 493.

Courses Primarily for Undergraduate Students

Courses in French

101, 102, 103. Elementary French. (2-0) Cr. 3 each. 101: F.W.S.S.; 102: W.S.S.S.; 103: F.S.S.S. Prerequisite: 101: Elementary sequence open to students with less than two years instruction in French at the high school level; 102: 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. Essentials of French grammar to permit use of the language as a research tool with aid of dictionary. For graduate students. Emphasis on problems of translation.

204. French Pronunciation. (2-1) Cr. 2. W.S. Prerequisite: Credit or classification in 211. Diction and intonation. Development of proper French accent through phonetics, mechanics of sound formation, syllabification, inflection, and intonation. Required for French majors.

207, 208, 209. Survey of French Literature. (3-0) Cr. 3 each Yr. Prerequisite: 103. Study of representative selections of French literature from its origins to modern times. Main emphasis upon reading comprehension. Lectures and discussions in English. Designed especially for nonmajors 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 seventeenth century; 208: Eighteenth and early nineteenth century; 209: Late nineteenth and twentieth century.

310. Negritude and Afro-French Literature. (3-0) Cr. 3. S. Prerequisite: 103. The Négritude movement and its founders: Senghor, Césaire, Dumas. Oral literary traditions of French-colonized Africa; special characteristics and contributions of Maghrib literature; current Third World poetry and prose in French from the newly emerging African states. Readings in French; lectures in English. Independent reading and reporting of new works with FOREIGN LANGUAGES 209
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212, 213. Intermediate French. (2-2) Cr. 3 each.

211: 165; 212: 211; 213: 212. Continued emphasis on development of aural-oral skills and master-
ty of basic principles of French grammar.

311, 312, 313. Elementary French Composition and

Conversaatton. (3-0) Cr. 3 each. Yr. Prerequisite: 213.

Continued review of grammar with a survey of literature

as a basis for composition and conversaaton practice and

improved reading skill. Incorporates an introduction to

techniques of explication de textes to develop critical

sense in preparation for advanced literature courses.

314, 315, 316. French Civilization. (3-0) Cr. 3 each.

Yr. Prerequisite: 213. Study of history, art, architecture,

music, social institutions of France. Lectures and dis-
cussions in French.

314: From Charlemagne through the Valois dynasty.

316: The Renaissance through the revol-

ution. 316: The Napolaeonc era through modern times.

401, 402, 403. Advanced French Composition and

Conversaatton. (3-0) Cr. 3 each. Yr. Prerequisite: 313.

Intensive composition and conversaaton practice using literary

masterpieces as a basis for development of an ap-

preciation for style, idiomatie usages, and effeetive

expression of ideas as well as for improvement of speaking and

writing skills. Increased emphasis on vocabulary building,

grammatical correctness, and compatibility of style and

content.

407, 408, 409. French Prose: The Development of the

Novel Form. (3-0) Cr. 3 each. Yr. Prerequisite: 313.

French prose from its beginnings to the present day

with special emphasis on the development of the novel form.

Lectures and discussion in French. 407: Early pro-
sesses and the emergence of enlightenment. 408: The century of

romantieism,现实ism, Naturalism. 409: The novel since

1900.

410, 411, 412. French Drama. (3-0) Cr. 3 each. Yr.

Prerequisite: 313. French dramatic literature from the

Middle Ages to the present day. Lectures and dis-
cussions in French. 410: Middle Ages and Renaissance

theater; the beginnings of the classical drama, Corneille.

411: Classical drama. Racine and Moliere; tragedy, com-

dedy, and the Drama Bourgeois of the eighteenth cen-
tury; romantieism, realism, and naturalism in the the-

ater. 412: The theater since 1900.

413, 414, 415. French Poetry. (3-0) Cr. 3 each. Yr.

Prerequisite: 313. Lectures and discussions in French.

413: Introduction to French prophy and textual

analysis as applied to poetry. 414: The Romantieks and the

Symbolists. 415: The twentieth century.

Courses in German

181, 182, 183. Elementary German. (3-2) Cr. 4 each.

131: F.W.SSI; 132: W.S.SSI; 133: F.S.SSI. Prerequisite:

131: Elementary sequence open to students with less than

two years spoken German at the high school level;

132: 131: 133: 132. Introduction to German through the

aural-oral approach with intensive use of the language

laboratory.

131A, 132A. Reading Knowledge of Scientific German

(3-0) Cr. R. 131A; SSI; 132A: SSI. Essentials of German

grammar to permit use of the language in research with

aid of dictionary, for graduate students. Emphasis on

problems of translation.

238, 237, 238. Intermediate German. (3-0) Cr. 3 each.

Yr. Prerequisite: 234; 238; 237: 236: 235: 237. Review of

grammar, selected readings, further practice in oral and

written communication.

338, 337, 338. German Civilization. (3-0) Cr. 3 each.

Yr. Prerequisite: 288. German history, art, and architec-

ture. Readings, lectures, and discussions in German. 336:

Germanic origins and migrations; Charlemagne and the

Carolingian Renaissance to 850. 337: The Holy Roman

Empire of the German Nation. Romanesque and gothic

art and architecture. 338: The Reformation; the Thirty

Years War; the rise of Prussia. Art and architecture since

1400.

399, 340, 341. Elementary German Composition and

Conversaatton. (3-0) Cr. 3 each. Yr. Prerequisite: 339;

Eighteen credits in German; 340: 339; 341: 340. Thorough

review of German grammar. Practice in writing and speak-

ing German.

342, 343, 344. Eighteenth Century German Literature.

(3-0) Cr. 3 each. Yr. Prerequisite: Eighteen credits in

German. 342: German literature of the Enlightenment.

Dramas and literary criticism of Lessing, Wieland and

the development of the German novel. Roccoco poetry.

343: German literature of the Storm and Stress period.

Klopstock, Herder, poetic theory, drama of social crit-

icism. Klinger, Lenz, young Goethe, young Schiller. 344:

German literature of the Classical Period. Influence of

Greece on Germany, humanism, Goethe, Schiller, and

Hillerlml.

345, 346, 347. German Literature from 1800 to the

Present. (3-0) Cr. 3 each. Yr. Prerequisite: Eighteen

credits in German. 345: German literature of the romantic

period. Readings and discussions in romantic concepts of

religion, art, poetry, folk literature, the Middle Ages,

and the supernatural. 346: German literature since 1830:

Young Germany, poetic realism and naturalism. Empha-
sis on development of the German theater. 347: Ten-

teenth century German literature from expressionism to

psychoanalysis; documentary writing. Interpretations and

evaluations of prose, fiction, drama, and poetry in cul-

tural context.

440. Goethe's Faust, Part I. (3-0) Cr. 3. F. Prerequisite:

344 or 347. Interpretation, including the Faust legend

and tradition in literature.

441, 442, 443. Advanced German Composition and

Conversaatton. (3-0) Cr. 3 each. Yr. Prerequisite: 341.

Intensive practice in composition and conversaaton, using

literary masterpieces as a basis for written and oral dis-

cussion.

Courses in Russian

121, 122, 123. Elementary Russian. (4-0) Cr. 4 each.

Yr. Prerequisite: 121. Open to students with less than

two years instruction in Russian at the high school level.

122: 121; 123: 122. Introduction to Russian through the

aural-oral approach. Essentials of grammar necessary for

reading, writing, comprehension, and conversaaton on an

elementary level.

224, 225, 226. Intermediate Russian. (3-0) Cr. 3 each.

Yr. Prerequisite: 224: 123; 225: 224; 226: 225. Systematic

review of grammar. Reading of Russian short stories. Com-

position and conversaaton.

324, 325, 326. Advanced Russian. (3-0) Cr. 3 each. Yr.

Prerequisite: Eighteen credits in Russian. Composi-

tion and conversaaton based on masterpieces of Russian

literature. Survey of Russian literature from the tenth cen-
tury to the present.

327, 328, 329. Russian Civilization. (3-0) Cr. 3 each.

Alt. Yr., offered 1973-74. Prerequisite: 228. Survey of

history, art, architecture, music, geography, and economic

development of the Russian nation. Lectures and dis-

cussions in Russian.

421, 422, 423. Advanced Russian Composition and

Conversaatton. (3-0) Cr. 3 each. Alt. Yr., offered 1974-

1975. Prerequisite: 421: 324, 322; 421: 323: 422: 423:

423: 422 intensive practice in writing and speaking Russian.

427, 428, 429. Literary Masters of the Nineteenth Cen-
tury. (3-0) Cr. 3 each. Alt. Yr., offered 1974-75. Prereq-

uisite: 326. Social and artistic trends in Russian life as

reflected in works of writers such as Pushkin, Lermontov,

Gogol, Turgenev, Tolstoy, Dostoevsky, and Chekhov. Lec-

tures and discussion in Russian.
Courses in Spanish


351, 352, 353. Introduction to Spanish Literature. (3-0) Cr. 3 each. Yr. Prerequisite: 253, 351: Highlights of the Renaissance and poetry of the eighteenth and nineteenth centuries. Lectures, readings, discussion, and limited individual research. 352: Selected readings from the Golden-Age novel, theater, and poetry. Highlights of Romantic theater and poetry. 353: Highlights of the Realistic novel, Post-Romantic poetry, and the novel and theater of the twentieth century. Readings, discussion, lectures, and limited research.


357, 358, 359. Spanish and Ibero-American Civilization. (3-0) Cr. 3 each. Yr. Prerequisite: 253. From earliest times to the present. Survey of the art and architecture, as well as the social structure of Spanish life. 359 is devoted exclusively to the study of Latin America. Lectures and discussion in Spanish.

464, 465, 466. Introduction to Spanish American Literature. (3-0) Cr. 3 each. Yr. Prerequisite: Twenty-four credits in Spanish. 464: The Colonial Period. Selected readings in historical and literary materials from the time of the conquest to the period of struggle for independence. 465: The nineteenth century. Selected readings from the period of the Mexican War in which Mexican literature is first written in Spanish, to the century of the revolution. 466: The Contemporary Period. Selected readings from prose and poetry of the twentieth century. Lectures and discussion in Spanish.

467, 468, 469. Advanced Spanish Composition and Conversation. (3-0) Cr. 3 each. Yr. Prerequisite: 467: 359; 468: 467; 469: 468. Intensive practice in writing and speaking with cultural essays and newspapers as a basis for conversations and compositions. Further increase of vocabulary and knowledge of idiomatic phrases and expressions. Emphasis on dictation and intonation.


477, 478, 479. Hispanic Drama. (3-0) Cr. 3 each. Yr. Prerequisite: Twenty-four credits in Spanish. 477: Drama of Spain from its origins through the Golden Age with emphasis on major dramatists of the Golden Age. Lectures, readings, discussion, and individual research. 478: Drama of Spain from the Golden Age to the present with emphasis on the nineteenth and twentieth centuries. Lectures, readings, discussion, and individual research. 479: Drama of Spanish America. Twentieth-century drama from Argentina, Cuba, Ecuador, Mexico, Panama, Chile, Puerto Rico, and other Spanish-American countries. Lectures, readings, and term papers.

Special Courses

476. Methods of Teaching Foreign Languages. (Educ 476) Cr. 3. W. Prerequisite: Eighteen credits in modern languages.

490. Special Problems. Cr. 1 to 9 each term taken. Prerequisite: Permission of department head. Designed to meet the needs of students who seek work in areas outside those courses are offered, or who desire to integrate a study of literature or language with special problems in major fields. H. Honors Program.


Forestry

Henry H. Webster, Head of Department

Professors: Bensend, Bultena, McNabb, Scholtes, Thomson.

Associate Professors: Beardsley, Gordon, Hopkins, Preston, Yoesting.

Assistant Professors: Dickmann, Meadows, Promnitz, Rose.

Undergraduate Study

The department offers work for the degree Bachelor of Science with majors in forestry and outdoor recreation resources. Specialization may be in administration and management, quantitative-analytical techniques or biological-physical relationships as they apply to the administration of forest resources, outdoor recreation resources, or wood products production and marketing.
Many private firms as well as federal, regional, state and local agencies seek graduates to fill positions in management of natural resources. The wood processing industries (such as pulp and paper, plywood, particle board, lumber, and others) offer professional opportunities in production, product development, quality control, and marketing.

With appropriate graduate study, the range of opportunities is expanded to include research and quality control, and marketing.

A six-week summer field studies program is normally prerequisite to admission to the junior year for students enrolled in the forestry curriculum. Students enrolled in the outdoor recreation resources curriculum may attend this field studies program on an elective basis. An outdoor recreation resource field inspection trip (For 490G) is also available.

Graduate Study

The department offers work for the degrees, Master of Science and Doctor of Philosophy with major in forestry and minor work to students taking major work in other departments. Areas of specialization for the M.S. degree are: forest administration and management, forest biology, forest biometry, forest economics and marketing, and wood science. Areas of specialization for the Ph.D. are: forest biology-wood science, forest biometry and forest economics. This graduate program is open to and suitable for students who have majored in forestry, outdoor recreation resources, other natural resource fields and related sciences. A nonthesis masters option is available.

The department also participates in the interdepartmental program of water resources. (See Water Resources.)

Open to graduate students for minor credit only:

101. Introduction to Forestry and Outdoor Recreation Resources. (3-2) or (3-0) Cr. 4 or S. W. Prerequisite: Evaluation of trends in demand for products and services obtainable from forest and outdoor recreation resources; discussion of current multiple-use operations; the satisfaction of recreational and aesthetic needs; implications for current and future management; management possibilities, problems, policy issues.


110. Orientation. (1-0) Cr. R; F. Orientation to activities and procedures of the Department of Forestry. Discussion of forestry and outdoor recreation resource management as a career. For satisfactory-fail credit only.

200. Forest Conservation. (3-0) Cr. 3. W. Evolution of forest conservation in the United States. Current public and private conservation policies. Forests in relation to human needs; conflicts between uses of forest resources. The department recommends that credit in both 101 and 200 not be applied toward graduation.

201. Forest Ecology. (0-6) Cr. 2. Summer field studies. Field-oriented study of the forest ecosystem and its manipulation for various productive uses of forest lands including water, timber, recreation, and forage.

202. Wood Utilization. (0-6) Cr. 2. Summer field studies. 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.


204. Multiple Use Operations. (0-6) Cr. 2. Summer field studies. Field study of forest and recreation resource problems and management programs. Interaction of user groups, forest industries, special-interest groups, resource agencies, and local communities. Examination of conflicts, issues, and alternative solutions.

241. Forestry and Outdoor Recreation Resource Measurement. (2-3) Cr. S. Prerequisite: Math 162; Com S 201, Stat 104. Measurement of forest and outdoor recreation resources. Principles of estimating by sampling and application for inventorying forest and outdoor recreation resources.

256. Dendrology. (Bot 256) See Botany.

300. Forest Resource Management. (3-0) Cr. 3. F. Prerequisite: 101. A technical overview of mensurational, cultural, and managerial methods of concern to the specialist in forest-related activities. Not open to forest resource management students.

301. Forest Biology. (2-2) Cr. 3. W. Prerequisite: Bot 107. Effects of genetic and environmental factors on processes underlying forest tree and stand growth.

302. Forest Vegetation Manipulation. (3-3) Cr. 4. S. Prerequisite: 301; Agron 357. The manipulation of forest vegetation in relation to ecological principles. All uses of forest vegetation considered.

341. Forestry and Outdoor Recreation Resource Surveys. (4-0) Cr. 4. Alt. S., offered 1975. Prerequisite: Stat 104. Methods for inventorying various forest resources and uses including range, water, and recreational resources. Estimating models and sampling schemes for providing estimates necessary to manage these resources within forestry context.


380. Wood Technology. (3-6) Cr. 5. F.W. Prerequisite: Biol 101. Anatomy, macroscopic identification, and introduction to chemical and physical properties of wood as related to processing.

388. Wood Liquid Relations. (3-3) Cr. 4. F. Prerequisite: 380; Chem 231 or equivalent. Cell wall structure; wood in relation to moisture; specific gravity; seasoning; protection of wood from insects and decay; fire retardant and stabilizing treatments.

390. Forest Protection. (2-2) Cr. 3. S. Character and extent of damage to forest by fire, weather, animals, and disease. Fire ecology, forest fire prevention, suppression, and suppression.

397. Forest Regulation and Operations. (3-0) Cr. 3. S. Prerequisite: 241, 301. Principles of organizing, regulating, and administering forest lands in conjunction with commercial harvest and multiple-use goals for both private and public ownership.


414. General Photogrammetry and Photo-Interpretation. (2-2) Cr. 3. W. Prerequisite: One quarter of surveying. Use of aerial and terrestrial photographs in forest management and research. Techniques of measurement, cartographic methods and interpretation applicable to controlled photographs.

416. Forest Pathology. (Bot 416) See Botany.

417. Wood Deterioration. (Bot 417) See Botany.


451. Management of Forest and Related Outdoor Recreation Resources: Economics and Marketing. (2-2) Cr. 3. S. Prerequisite: 241, or 344; Econ 242. Economic factors and analytical methods influencing decisions by forest and related outdoor recreation resource agencies and firms. Marketing of services and products provided by such agencies and firms; influence of population, income, and related economic and social factors.

453. Management of Forest and Related Outdoor Recreation Resources: Quantitative Analysis. (3-2) Cr. 4. F. Prerequisite: 451. Methods of rigorously identifying and specifying problems involved in management, protection and use of forest and related outdoor recreation resources. Application of mathematical and statistical models to solving these managerial problems. Design and collection of information for use in these models.

455. Management of Forest and Related Outdoor Recreation Resources: Policy and Administration. (3-0) Cr. 3. W. Prerequisite: 452; Pol S 215. Analysis of the political, institutional, and administrative processes involved in the formulation of public and private policy concerning major forest and related outdoor recreation resource issues.

458. Management of Forest and Related Outdoor Recreation Resources: Integrated Case Studies. (1-4) Cr. 3. S. Prerequisite: 453. Management of a case study involving management and related outdoor recreation resources management to illustrate methods of synthesizing the economic, mathematical, biological, political, and administrative principles discussed in preceding courses.

460. Forest Recreation. (3-0) Cr. 3. W. Prerequisite: 451 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.


489. Social Behavior and Environmental Resources. (Soc 482) See Sociology.


494. Properties of Wood. (3-9) Cr. 3. Alt SS, offered 1973. Prerequisite: 301. 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.

496. Wood Composite Products (3-3) Cr. 4. Alt F., offered 1973. Prerequisite: 380, one course in organic chemistry. Principles of adhesion, chemistry of wood adhesives, production of laminated wood, plywood, particle board and fiberboard products. A weekly seminar on the properties of materials other than wood and a field inspection trip.


489. Wood Products Seminar. (0-2) Cr. 1. S. Prerequisite: Senior classification. Application of the principles of wood science to current industrial problems; detailed analysis of current events in the industry. Student presentation involved.

490. Special Problems. Cr. 1 to 6 each time elected. Prerequisite: Junior classification, permission of instructor.

A. Forest Biology.
B. Wood Technology.
C. Forest and Outdoor Recreation Economics.
D. Forest and Outdoor Recreation Management.
E. Range Management.
F. Forest Biometry and Photogrammetry.
G. Field Inspection Trip
H. Honors Program.

491. Forest Range Management. (3-0) Cr. 3. F. Prerequisite: Econ 242; Bot 310; Bot 301 or 424. The place of range management in multiple-use forestry. Historical development of grazing in America. Grazing regions of the United States. Effects of grazing on physiology and ecology of plants. Technical problems in range and ranch management.

Courses Primarily for Graduate Students, major or minor, open to qualified undergraduates

504. Applied Forest Biology. (3-0) Cr. 3. Alt S., offered 1976. Prerequisite: 302. Detailed analysis of the practice of silviculture in relation to silvicultural principles with emphasis on silviculture for purposes other than conventional timber products.

543. Forest Biometry. (3-0) Cr. 3. Alt W., offered 1976. Prerequisite: 442. Estimation of current stand volume and of stand growth. Selection of variables for volume and yield tables. Applications of sampling methods to forest resource surveys.

570. Economics of Forest and Related Outdoor Recreation Resources Management. (2-2) Cr. 3. Alt F., offered 1973. Prerequisite: 451; Econ 301. Economic analysis of forest and related recreation resource management alternatives as found in forest-oriented firms and agencies, with emphasis on methodology.

587. Advanced Topics in Wood Science. (3-0) Cr. 3. Alt W., offered 1974. Prerequisite: 380. Recent contributions of research and technology to product development. Areas of emphasis in basic and applied research.

589. Special Topics. Cr. 2 to 5 each time elected. Prerequisite: Select credits of acceptable graduate work, permission of the instructor.

A. Forest Biology.
B. Wood Science.
C. Forest and Outdoor Recreation Economics.
D. Forest and Outdoor Recreation Management.
E. Range Management.
F. Forest Biometry and Photogrammetry.

594. Advanced Forest and Outdoor Recreation Resource Management. (3-0) Cr. 3. Alt F., offered 1974. Prerequisite: 397. A seminar approach to the critical analysis of forest and related outdoor recreation management problems as exemplified in public agencies and private firms.
Courses for Graduate Students, major or minor


699. Research. Cr. 1 to 11.
A. Forest Biology.
B. Wood Science.
C. Forest and Outdoor Recreation Economics.
D. Forest and Outdoor Recreation Management.
E. Range Management.
F. Forest Biometry.

Genetics

William J. Weishons, Head of Department

Professors: Hollander, Peterson, Pollak, Robertson, Sadanaga.
Associate Professors: Atherly, Imsande, Miller.
Assistant Professors: Doerschug, Stadler.

Undergraduate Study

The Department of Genetics offers instruction in the science of heredity, and in the operation of the laws of inheritance in animals, plants, microorganisms, and human populations. The courses also are intended to demonstrate the broad cultural and philosophical aspects of this biological science.

Graduate Study

The department offers work for the degrees Master of Science and Doctor of Philosophy with major in genetics, and minor work to students taking majors in other departments.

No foreign language is required of candidates for the degree Master of Science. Candidates for the degree Doctor of Philosophy are required to pass the Educational Testing Service graduate examination for one foreign language at a level equivalent to the 60th percentile or better of the fourth semester undergraduate norms.

Prerequisite to major work is the completion of a thorough undergraduate curriculum in a biological science, or in a physical science or in agriculture with evidence of excellent scholarship and aptitude for scientific research.
The department offers the student the opportunity to work in such areas as Drosophila, maize, oat, mouse, immunological, microbial, biochemical and developmental genetics. Minor work may be taken in agronomy, animal science, bacteriology, biochemistry, botany, horticulture, mathematics, statistics, veterinary medicine or zoology.

The department also participates in the interdepartmental programs of cell biology and immunology. (See Cell Biology or Immunology.)

Open to graduate students for minor credit only: 401, 460.

Courses Primarily for Undergraduate Students

305. Elementary Genetics Laboratory. (0-6) Cr. 2 F.S. Prerequisite: 340 or 350. Laboratory experiments illustrating the laws of heredity and their physical basis.

3340. Introductory Genetics. (3-0) Cr. 3. F.W.S.S.S. Prerequisite: Biol 101 or equivalent. Principles of genetics in plant and animal (including human) populations with emphasis on classical genetic analysis.

3350. Principles of Genetics. (3-0) Cr. 3. F.W.S. Prerequisite: Biol 101A, Chem 251, or 333, or 335. An initial course exploring the principles of genetics with emphasis on molecular aspects of gene structure and function.

3360. Heredity and Society. (3-0) Cr. 3. F.S. Prerequisite: Biol 101 or equivalent, or Anthro 219; junior or senior classification. This course is intended as an introductory course in genetics for nonbiology majors who are interested in heredity and its importance, and implications to self and society. It is not recommended for those intending to take advanced courses in genetics. Topics included are evolution, the informational machinery of the cell, laws of inheritance, population genetics, human inheritance, and social, ethical, and political issues in genetics.

400 Human Heredity. (3-0) Cr. 3. S. Prerequisite: Biol 101 or equivalent; junior or senior classification. Principles of genetics as applied to human populations, including sex determination, sex linkage, inheritance of dominant and recessive traits, applications of the Hardy-Weinberg formula to the inheritance of blood types, and recessive factors.

401. Intermediate Genetics. (3-0) Cr. 3. F. Prerequisite: 340 or 350. Fundamental methods and concepts in genetics: chromosome mapping, gene structure, elementary mathematical genetics, polyploidy, and melotic analysis.

402. Introduction to Mathematical Genetics. (3-0) Cr. 3. S. Prerequisite: 401, knowledge of elementary algebra. Poljak. Elementary probability and its application to Mendelian, population, and quantitative genetics.

490. Special Problems. Cr. arr. Prerequisite: 305; 401.

†The department recommends that credit for more than one introductory course in genetics (340, 350, 360, or 400) not be applied toward graduation.

Courses Primarily for Graduate Students, major or minor, open to qualified undergraduates


550. Special Topics. (0-3 to 9) Cr. arr. Prerequisite: 305, 401.

Courses for Graduate Students, major or minor

605. Cytogenetics. (Bot 605) (3-0) Cr. 3. W. Prerequisite: 401; C Bio 527. Robertson. Studies of cytology and genetics in plants and animals with emphasis on crossing over and changes in chromosome structure and number.

615. Laboratory in Cytogenetics. (0-6) Cr. 2. S. Prerequisite: 605. Sadanaga. Laboratory methods and techniques for cytogenetical research, with emphasis on plants.

619. Developmental Genetics. (3-0) Cr. 3. Alt. S., offered 1975. Prerequisite: 340 or 350; B & B 406. Doerachug. Mechanisms involved in the regulation of gene expression as related to cell differentiation and development in higher organisms. Emphasis will be on both genetic and biochemical aspects of development.


621. Bacterial Genetics. (Bact 621) See Bacteriology.

630. Advanced Plant Genetics. (3-0) Cr. 3. S. Prerequisite: 401. Robertson. Genetical analysis of plants including evolution, biochemical genetics, translation of genetic information, cytoplasmic inheritance, incompatibility systems, alterations of melosis, and sex determination.


640. Genes and Mutations. (3-0) Cr. 3. Alt. W., offered 1974. 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.


690. Seminar. Cr. 1. F.W.S.


699. Research.

Geography

For description of course, see Earth Science.

Geology

For description of courses, see Earth Science.
History

Louis G. Geiger, Chairman of Department

Professors: Kotman, Ross, Sharlin.
Associate Professors: Apt, Dobson, Moody, McJimsey, Whitaker.
Assistant Professors: Avraamides, Bennett, Cravens, Hacker, Jones, Keller, McCarthy, Madison, Osborn, Rawson, Wilt, Zaring.

Instructor: Schwieder.

Undergraduate Study

For the undergraduate curriculum in sciences and humanities, with major in history, leading to bachelor's degree, see Sciences and Humanities, Curriculum.

The department offers introductory courses designed for all students as part of their general education, or as an introduction to further study in their field. The department also offers courses for advanced undergraduate work in United States history, Latin American history, European history, Asian history, and history of science and technology.

The prospective major may earn either a Bachelor of Arts or Bachelor of Science degree. Candidates for the Bachelor of Arts must complete a two-year foreign language sequence in one language. Certainly, if he or she entertains ambitions to pursue graduate work, proficiency in a foreign language is essential.

Thirty-five credit hours represent the minimum requirement for a major in history, seventy credits the maximum. Only one 200-level survey sequence may be used to satisfy the minimum credit requirement. History 399 is required of all majors.

The college requires no minor. Those students who prefer minors usually choose from such complementary disciplines as political science, English, sociology, psychology, economics, philosophy, or foreign language.

Students majoring in history may also earn a second major in international studies. See International Studies.

A prelaw undergraduate program may be pursued through a major in history. For a more detailed statement, see Preprofessional Programs.

Students can prepare to teach history in the secondary schools. For the University statement of requirements for teacher certification, see College of Education.

For additional courses concerning Latin America, East Asia, and Africa, see Distributed Studies.

Graduate Study

The department offers work for the degree Master of Arts with majors in history and in history of science and technology, and minor work to students majoring in other departments. Both programs are designed to enable a graduate to teach in high schools and junior colleges, enter government service, or pursue further study.

The foreign language requirement, if any, is determined by the student's advisory committee. Students may elect either a nonthesis program or a thesis program. Those choosing a nonthesis program will take oral comprehensive examinations over two fields of history, such as twentieth century America and modern Germany. Those writing a thesis will be examined orally on the thesis and its related area of specialization. For further information, write to the chairman.

Open for graduate minor credit: any 400-level course.

Courses Primarily for Undergraduate Students

*201, 202, 203. Western Civilization. (3.0) Cr. 3 each Yr. Social and cultural development of western civilization from the ancient Near East to the present, emphasizing western economic and political ideas and institutions; problems of historical change and continuity; basic methodology.

*221, 222, 223. History of the American Nation. (3-0) Cr. 3 each Yr. 221: National foundations. Colonial background; revolution; confederation and constitutions; nationalism and democracy. 222: National expansion and internal conflict. Forces of unity and disunity, division and reunification. 223: National consolidation and world power; emergence of the new nation; modern industrialism and international relations.

286. Black and White in America. (3.0) Cr. 3. S. Historical trends in race relations from 1619 to present. Slavery, segregation, and nature of black and white protests against these institutions.


340, 341, 342. History of China. (3.0) Cr. 3 each Yr. Prerequisite: 341: 340; 342: 341. 340: Intellectual, cultural, economic, and social developments from earliest times to about 600 A.D. 341: Impact of internal and external factors on nineteenth century China, leading to reform and revolution. 342: Twentieth century China in revolution, 1900 to the present.

*350, 351, 352. History of Latin America. (3-0) Cr. 3 each Yr. Prerequisite: 350: Pre-Columbian civilizations; Spanish and Portuguese discovery and colonization in America; development of colonial institutions to 1760. 351: Bourbon reforms of the late eighteenth century; wars of independence; organization of national states. 352: Society, economy, and politics of twentieth century Latin America.

370. History of Iowa. (3.0) Cr. 3. F.W.S. Survey of major social and economic developments in Iowa from the late 1700's. Emphasis on minority groups, pioneer life, agricultural and industrial development, and outstanding personalities.

375A, 375B. History of American Agriculture. (3-0) Cr. 3 each Yr. 375A: F.; 375B: W. American agricultural development from colonial times to the present. 375A: European background, colonial period to 1865. 375B: 1865 to the present.

*382, 383. Economic History of the United States. (3-0) Cr. 3 each Yr. 382: F.; 383: W. Prerequisite: Sophomore
classification. Growth of important industries, regional specialization, development of economic institutions, relations of government to business enterprise. 382: To 1877; 383: Since 1877.

387A, 387B. Military History of the United States. (3-0) Cr. 3 each. 387A: W.; 387B: S. Prerequisite: 387B; 387A. 387A: Growth of American military institutions in the context of the western military tradition from the Renaissance to the end of World War I. 387B: The military and American Society in the twentieth century.

399. Historical Technics. (3-0) Cr. 3. F. Introduction to methodology for students majoring in history. Bibliographic techniques, methods of evaluating source materials, conducting research, and writing history.

*403A, 403B, 403C. Ancient History. (3-0) Cr. 3 each. 403A: Ancient Near East, Mesopotamia and Egypt to the Persian Empire. 403B: Ancient Greece, prehistory to the Hellenistic world. 403C: Ancient Rome, founding of the Republic to Constantine.

*404A, 404B, 404C. History of Medieval Western Europe. (3-0) Cr. 3 each. Yr. Development of political, economic, and social institutions. 404A: Early Middle Ages; 404B: High Middle Ages; 404C: Late Middle Ages.

407. The Italian Renaissance. (3-0) Cr. 3. W. Secularization of society, city-states, economic growth and decline, new intellectual interests, historiography.

408. Europe: 1500 to 1648 (Reformation). (3-0) Cr. 3. The Northern Renaissance; emergence of religious dissent; Protestant revolt; triumph and tragedy of Spain; victory of Calvinism; reaction and reform within Roman Catholicism; religious wars and the emergence of France.

*410A, 410B, 410C. Contemporary Europe. (3-0) Cr. 3 each. Yr. 410A: The age of European preeminence, 1871 to 1914; 410B: The Great War and interwar Europe; 410C: Europe since 1930.

*411A, 411B. Economic History of Modern Europe. (3-0) Cr. 3 each. 411A: Economic and political revolutions 1750-1900; English and continental heritage from medieval Europe; commercial, industrial, agricultural revolutions; economic institutions and reforms; capitalism, competition, imperialism. 411B: Rise of continental industry; changes in labor, transportation, markets, reparations, revolutions, reconstruction, competition, depression, and war.


*415A, 415B. History of France. (3-0) Cr. 3 each. Alt. Yr. An analytical history of France. 415A: From Louis XIV through Napoleon. 415B: From the Revolution of 1848 to the present.

*416A, 416B, 416C. History of Russia. (3-0) Cr. 3 each. Yr. 416A: Kievan and Muscovite Russia, 880-1700. Origins of Russian state; Mongol invasions; rise of Moscow. 416B: Imperial Russia, 1700-1917. Peter the Great and his successors; impact of the West; eve of the Revolution. 416C: Soviet Union, 1917 to present. Revolution and Russian society; emergence of the USSR as a world power.


*422A, 422B. Eighteenth and Nineteenth Century Britain. (3-0) Cr. 3 each. 422A: W.; 422B: S. 422A: Great Britain, 1688 to 1815. Growth of Britain to a world power. Emphasis on cultural, political, and military developments. 422B: Great Britain, 1815 to 1914. Britain as the world power. Emphasis on political, economic, and social developments.

*430A, 430B, 430C. History of Science. (3-0) Cr. 3 each. Yr. 430A: Prehistory to Copernicus: Development of natural science in Babylonia, Egypt, China, India; Greek science; medieval and Arabic science. 430B: Beginnings of modern science; the sixteenth, seventeenth, and eighteenth century revolutions in astronomy, mechanics, biology, and chemistry. Emergence of scientific societies and the experimental method. 430C: Modern science: Development of physics, chemistry, and biology in the nineteenth and twentieth centuries.


485. Science in Modern American Society. (3-0) Cr. 3. Alt. Yr. A social history since the 1840's. Interrelationship between science as a powerful instrument of modernization, and the development of the urban industrial social order in America.

441. Philosophy of History. (3-0) Cr. 3. S. Philosophy, concepts of causality, time, determinism, nature, and generalization.

443. Modern Japanese History. (3-0) Cr. 3. S. Political, cultural, social, and economic history of Japan, particularly since 1853.

444. Modern Middle East. (3-0) Cr. 3. Alt. Yr. The Arab countries, Israel, Iran, and Turkey in the nineteenth and twentieth centuries.

453. History of Mexico. (3-0) Cr. 3. F.W. Mexico since independence, with emphasis on the Mexican Revolution as the central factor in development of contemporary Mexico.

*462A, 462B, 462C. Colonial America. (3-0) Cr. 3 each. Yr. Economic, political, and social development of the American colonies through the American revolution.

464. The Jacksonian Movement. (3-0) Cr. 3. Alt. S. offered 1974. Origins, development, and significance of Jacksonian democracy in determining and revealing the nature of American economic, social, and political mores and institutions.

466. Sectional Conflict and the Civil War. (3-0) Cr. 3. F. Economic, social, political, and psychological conflicts which undermined the democratic process and drove the United States to Civil War.

*466A, 466B. The Reconstruction Era and the Gilded Age. (3-0) Cr. 3 each. 466A: W.; 466B: S. Major social and political features of the United States following the Civil War. 466A: The decision to reconstruct the South; accomplishments and failures of reconstruction, 1865 to 1877. 466B: U.S. transition from agrarian society to industrial giant, 1877 to 1900.

*469A, 469B, 469C. Twentieth Century America. (3-0) Cr. 3 each. Yr. Major political, economic, and social development of the United States since 1914. Emphasis on growth of the government as a regenerative force in American society. 469A: Progressive Movement, home front during WWI, red scare, and post-war reaction. 469B: New economic era of the 1920's, depression, Hoover administration, the New Deal. 469C: Wartime America, Fair Deal, Modern Republicanism, The New Frontier, the Great Society, and the Nixon administration.


473. The American Social System in the Industrial Era. (3-0) Cr. 3. Alt. Yr. Emphasis on development of impersonal bureaucratic institutions in the U.S., and their influence on mobility, stratification, individualism, conformity, and freedom; from 1840 to present.
474A, 474B. The Westward Movement and Frontier Development. (3-0) Cr. 3 each. 474A: F.; 474B: W. 474A: Occupation, distribution, and political organization of the public domain; Indian-white relations; 474B: Economic exploitation of the public domain (fur trade, mining, lumbering, range cattle industry, farming), social adjustments (law and order, religion, education, and culture).

477A, 477B, 477C. History of United States Foreign Policy. (3-0) Cr. 3 each. Yr. Diplomatic history emphasizing penetration of American influence in those areas where the United States has exercised leadership 477A: Diplomacy from the American Revolution to post-Civil War expansionism. 477B: America’s rise as a world power from the Spanish American War to World War I; peace making. 477C: Diplomacy of 1920’s to present.

478A, 478B. U.S.-Soviet Relations. (3-0) Cr. 3 each. 478A: F.; 478B: W. Diplomatic issues between the two states from inception of the Soviet Union to present. 478A: From American Intervention in the Russian Civil War through the Yalta Conference in 1945. 478B: The Cold War.

490. Special Problem. Cr. 1 to 3 each time taken. Prerequisite: Permission of department chairman; 9 credits in history. Reading and reports on problems selected in conference with each student. H. Honors Program.

Any course may be taken independently.

Courses Primarily for Graduate Students, major or minor, open to qualified undergraduates


520. Topical Studies in History. (4-0) Cr. 4 each time taken. Prerequisite: Nine hours of history, and permission of instructor. Graduate study in conjunction with a 400-level course in the fields designated below. May not be taken in conjunction with a 400 level course in which the student has previously earned credit.


561. Technology in Developing Countries. (Engr 561) See Engineering.

590. Special Topics. Cr. 1 to 3 each time taken. Prerequisite: Permission of instructor.

591A, 591B, 591C. Seminar in History of Science. (3-0) Cr. 3 each. Yr. Prerequisite: Permission of instructor. 591A: Creativity in sciences and humanities. Comparison of careers in these fields. Reasons for choice of career and how originality is expressed. 591B: Relation between science and technology. Effects of technological change on scientific thought and new theories on technology. Prehistory to present. 591C: History of science and technology.

592. Seminar in East Asian History. (3-0) Cr. 3. S. Prerequisite: Permission of instructor. Topics vary each time offered.

593. Seminar in American History. (3-0) Cr. 3 each time taken. Prerequisite: Permission of instructor. Topics vary each time offered.

594. Seminar in European History. (3-0) Cr. 3 each time taken. Prerequisite: Permission of instructor. Topics vary each time offered.

595. Seminar in Teaching of History. (3-0) Cr. 3 each time taken. Prerequisite: Permission of instructor. Topics vary each time offered.

596. Historical Methods. (3-0) Cr. 3. F. Prerequisite: Permission of instructor. Original sources, bibliography, criticism of evidence, form.

Courses for Graduate Students, major or minor

698. Research.

Home Economics

Helen LeBaron Hilton, Dean of Home Economics.
Julia Faltinson Anderson, Associate Dean.
Marguerite M. Scruggs, Associate Dean for Graduate Study and Research.
Lydia L. Inman, Coordinator of Resident Instruction.
Sandra E. Sime, Career Counseling, Placement Director.

Associate Professor: Buchanan.
Assistant Professor: Korslund.
Instructors: Cain, Hewitt, Kiser, Seitz, Vyverberg, Warman.
Courses Primarily for Undergraduate Students

190. Self Study and Career Choice in Home Economics (2-0) Cr. 2. W. Prerequisite: Permission of instructor. Analysis of one's goals, interests, and abilities in relation to woman's roles in society, and career opportunities in home economics. Enrollment limited to freshmen and sophomores in home economics.

250. Cooperative Work-Study Program. Cr. arr. F.W.S.S. Offered on satisfactory-fall basis only.

400. Professional Relations Cr. R; F.W.S.S. Offered on satisfactory-fall basis only. Procedure in securing positions. Employer-employee relationship.

440. Interdepartmental Seminar. Cr. 1 to 3. F.W. Offered on satisfactory-fall basis only.
A. General.
H. Honors.

450. Cooperative Work-Study Program. Cr. arr. F.W. S.S. Offered on satisfactory-fall basis only.

490. Special Problems. Cr. arr. Offered on satisfactory-fall basis only.
A. General.
H. Honors.

Courses for Graduate Students, major or minor

540. Seminar. Cr. arr. F.W.S.

590. Special Topics. Cr. arr.

Home Economics Education

Ruth P. Hughes, Head of Department

Professors: Chadderdon, Fallgatter, Inman, Kohlmann, Paddock, Scruggs.

Associate Professors: Beavers, Gienger, Thomas.

Assistant Professors: Fanslow, Huyck, Magilton, Miller, Redick, Smith, Zimmerman.

Instructor: Ebert.

Undergraduate Study

For undergraduate curriculum in home economics education leading to the degree Bachelor of Science, see Home Economics Education, Curriculum.

The department offers work for the degree Bachelor of Science with major in home economics education. The curriculum is planned for those who wish to prepare for teaching in a variety of home economics programs, including career and vocational education in junior and senior high schools, and in adult education.

Students may enroll in the department as sophomores but must apply to and be accepted by the departmental committee and the College of Education Committee on Academic Standards in order to advance to the teacher education program or preparation for extension service. For the teacher education program, including requirements for teaching certification, see College of Education.

Career and Vocational Education Qualifications

The Department of Home Economics Education is approved by the State Department of Public Instruction, Career Education Division, for the preparation of teachers who desire to teach in approved vocational home economics 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. Edu 468 should be included. In addition, electives should be considered in consultation with the state leader of home economics extension programs, the coordinator of extension personnel training or assistant state leaders of home economics extension. See also Extension Services.

Graduate Study

The department offers work for the degrees Master of Science and Doctor of Philosophy with major in home economics education and minor work to students taking major work in other departments.

A student expecting to do major work should have fundamental knowledge of psychology, education, sociology, and home economics. The exact requirements will depend upon the field of work the student expects to pursue.

A foreign language is not required for the degrees Master of Science or Doctor of Philosophy. Statistics is included in the program of study for both degrees with a higher level of competence required for the degree Doctor of Philosophy.

Courses Primarily for Undergraduate Students

206. Introduction to Home Economics Teaching (2-0) Cr. 2. F.W.S. Prerequisite: Sophomore classification. Concepts and attitudes about home economics teaching. Opportunities for teaching and interacting with students. Orientation to various aspects of home economics education.

406. Methods of Teaching Home Economics. (4-0) Cr. 4. F.W.S. Prerequisite: Educ 305, admission into teacher
preparation program. Responsibilities of home economics educators in applying principles of learning and of adolescent development to instruction. Philosophy of home economics and career education.


410. Planning and Evaluating Home Economics Programs. Cr. 4. F. W. S. Prerequisite: 407, 417. Developing plans for home economics educational programs for youth and adults of varied abilities and socioeconomic levels.


417. Supervised Experiences in Home Economics Education. Cr. 3. F. W. S. Prerequisite: Concurrent registration in 407. Supervised professional experiences in educational programs involving community organizations, agencies, and key persons in the community and the school who work with individuals and families.

490. Special Problems. Cr. arr.
A. Adult Education.
C. Curriculum.
D. Evaluation.
E. Extension.
G. General.
H. Honors.
I. Occupational Experience.

Courses Primarily for Graduate Students, major or minor, open to qualified undergraduates

500. Short Course. Cr. arr. S. S. Prerequisite: Permission of instructor.
A. Adult Education.
B. Evaluation.
C. Curriculum.
D. Teaching Strategies.
E. Supervision.
F. Teacher Education.

505. Workshop. Cr. 1 to 5. S. S. Prerequisite: Permission of instructor. Concentrated group study of problems in fields of home economics education. Sections offered will vary from year to year.
A. Adult Education.
B. Evaluation.
C. Home Economics Curriculum.
D. Supervision and Administration.
E. Special.

507. Curriculum Developments in Teaching Home Economics. (3-0) Cr. 3. F. S. S. Prerequisite: Teaching experience. Application of new knowledge and educational theory to curriculum planning. Philosophy of vocational education including career education concepts.

508. Post Secondary and Adult Programs. (3-0) Cr. 3. W. Prerequisite: Six credits in education and/or educational psychology. Planning, organizing, and evaluating home economics programs for post secondary and adult students. Coordinating with organizations, agencies, and industries in promoting programs.

509. Teaching for Home Economics Related Occupations. (1-2) Cr. 2. S. S. S. Prerequisite: Six credits in education and/or educational psychology. Planning and conducting courses for training adolescents and adults in home economics related occupations. Planning, arranging and supervising business and industrial training experiences.


590. Special Topics. Cr. arr. Prerequisite: Six credits in education or educational psychology.
A. Adult Education.
B. Administration.
C. Curriculum.
D. Evaluation.
E. Extension.
F. Supervision.
G. General.
H. Teacher Education.
I. Research Methodology.

Courses for Graduate Students, major or minor

605. Home Economics Curriculum. (3-0) Cr. 3. S. S. Prerequisite: Fifteen credits in education and teaching experience. Kohlmann, Curriculum building applied particularly in home economics for secondary schools and higher education.

606. Educational Leadership and Supervision in Home Economics. (3-0) Cr. 3. S. S. S. Prerequisite: Five credits in graduate courses in home economics education. Thomas. Objectives, principles, and functions of supervision in student teaching, school systems, and state departments of education.

608. Philosophy of Home Economics Adult Education. (3-0) Cr. 3. S. S. Prerequisite: 508 or experience in adult education. Vanraes. Needs of various age and social groups. Formal and informal methods and techniques appropriate for adults. Findings of research in home economics adult education.

610. Seminar. Cr. 1 each quarter. W. S. S.

611. Design of Research in Home Economics Education. (3-0) Cr. 3. F. S. S. Prerequisite: Credit or classification in Educ 552 or Stat 401. Fasalow. Exploratory, descriptive, quasi-experimental, experimental, and historic research designs. Needed research in home economics education. Planning a research study. Evaluation of research reports.


699. Research.

Honors Program
Edwin C. Lewis, Assistant Vice President for Academic Affairs

The Iowa State University Honors Program offers an opportunity for qualified students to develop an individualized program of study to enable them to obtain maximum benefit from their undergraduate career. It is intended to meet the needs of capable students who have demonstrated the ability and maturity to assume more than the usual responsibility for their education. The Honors Program student determines his educational objectives and devises a program of study to meet these objectives.
An honors program may include the waiving of required courses, the combination of courses from several departments into unique programs, unusual concentration on independent study and research, and many other forms of innovation.

Each undergraduate college operates its own Honors Program with a college committee responsible for its administration. This committee admits students into the Program and approves their educational plan. The chairmen of the college committees compose the University Honors Program Committee, which is responsible for general coordination of the Honors Program.

Eligibility

Students ordinarily become eligible for admission to the Honors Program during the third quarter of their freshman year (second quarter for transfer students) and remain eligible for admission as long as they have at least 72 credits remaining before graduation. Admission is based partly on the student's grade average at the time of his application, as well as other evidence of exceptional ability and potential.

Special Educational Opportunities

The University Honors Program conducts Honors seminars, open only to small groups of Honors Program students. Honors seminars are listed under University Studies 321H, 322H, and 323H, and are offered only on a satisfactory-fail basis.

Honors courses open only to Honors Program students, and Honors sections of regular courses, are offered by various departments and are announced as they become available. An Honors Program student may also obtain Honors credit for work in any course by making appropriate arrangements with the instructor.

Many departments offer opportunities for independent study or research under Special Problems listings. When designated by H, a special project thus listed will carry Honors credit.

Further information concerning the Honors Program may be obtained from the Honors Program office, Room 102, Botany Hall.

Horticulture

Ervin L. Denisen, Chairman of Department

Professors: Cott, Mahlstede, Nichols, Pickett, Volz.
Associate Professors: Bauske, Buck, Hodges, Kelley, Sherwood, Vance, Weigle.
Assistant Professors: Cook.
Instructors: Beck, Blaine, Stang.

Undergraduate Study

For undergraduate curriculum in horticulture leading to the degree Bachelor of Science, see Horticulture, Curriculum.

The curriculum in horticulture with its four minors is designed for students desiring (1) technical horticulture with emphasis either in general horticulture, ornamental horticulture, floriculture, fruit and vegetable production, nursery management, or turfgrass management; (2) horticultural business; (3) horticultural science; and (4) horticultural teaching with emphasis on teaching general horticulture or extension horticulture.

Horticulture offers a career for both urban and rural students and for both men and women.

The broad field of horticulture provides new and expanded opportunities through current developing local, state, and national programs of beautification and recreation, teaching horticulture at high school and post high school levels, public arboretums and gardens, and food production for developing nations and disadvantaged citizens. The present curriculum minors have been designed to meet these needs and opportunities plus the traditional areas of study in horticulture.

Graduate Study

The department offers work for the degrees Master of Science and Doctor of Philosophy with major in horticulture, and minor work for students taking major work in other departments. Within the major the student may specialize in fruit crops, vegetable crops, floriculture, nursery crops, ornamentals, and turfgrass. Under special circumstances a nonthesis master's degree is available.

Prerequisite to major graduate work is the completion of courses covering the general field of horticulture or botany and the underlying sciences.

Students with major interest in fruit crops, floriculture, vegetable crops, nursery crops, ornamentals, or turfgrass should present 15 credits of undergraduate work in horticulture, botany, landscape gardening, or agronomy. The student also should have a working knowledge of inorganic and organic chemistry, general botany, and soils equivalent to the requirements outlined in the general curriculum for horticultural students at this institution.

Students taking major work in horticulture usually will take minor work in agronomy, genetics, botany (physiology, pathology, cytology, or morphology), entomology, statistics, or chemistry.

There is no uniform foreign language requirement for either the degree Master of Science or Doctor of Philosophy.

The department also cooperates in the interdepartmental program of water resources. (See Water Resources.)

Open to graduate students for minor credit only: 413, 422, 446, 447, 467, 480, 481.
Courses Primarily for Undergraduate Students

110. Introduction to Horticulture. (1-0) Cr. R. F. Introduction of first-year students to the field of horticulture; assistance in learning how to use facilities of the University and department to advantage.


154. Greenhouse Methods. (2-2) Cr. 3. W. Principles and methods of plant growing under glass, greenhouse construction and equipment.


224. Small Fruits. (2-2) Cr. 3. A. Prerequisite: 114A. Principles and practices involved in handling and commercial plantings of vineyards and plantations of strawberries, blue fruits, and miscellaneous small fruits.

244. Garden Flowers. (3-0) Cr. 3. S.S.S.I. Culture and use of important garden flowers including annuals, perennials, bulbs, flowering vines, rock- and water-garden plants.

247A, 247B. Floral Design. 247A: (1-2) Cr. 2. F.W.S. 247B: (1-4) Cr. 3. Alt. W., offered 1974. Prerequisite: 247A: Not open to horticulture majors without permission of instructor; 247B: Open only to horticulture students. Principles, mechanics, and uses of flower arrangements; conditioning and preparation of floral arrangement material; exhibiting and judging flowers and flower arrangements.

254. Vegetable Crops. (3-0) Cr. 3. S. Prerequisite: 114 or Bot 107. Principles and practices of vegetable production. Methods of maximizing yield and quality of vegetables. Harvesting, storage, and marketing.

314. Turfgrass Management. (Agron 314) (3-0) Cr. 3. F. Establishment and management of turfgrasses. Course examines grasses adapted to the Midwestern region, their classification, varieties; peculiarities of turfgrass establishment and management for home lawns, golf courses, athletic fields, and sod production. Special topics include fertilization, irrigation practices, soil drainage, and weed, insect, and disease control.

316. Nursery Management. (2-2) Cr. 3. S. Prerequisite: Three credits in horticulture. Equipment, including land, packing sheds, storage sheds, frames, glass houses, irrigation devices; large scale propagation; transplanting and management of plants; relation to other fields of horticulture; protection of nursery plants from climatic, disease, and insect difficulties.

321. Tree Fruits. (2-2) Cr. 3. F. Prerequisite: 114. Varieties, pest control, harvesting, grading, packing, and storage of orchard crops.

325. Nut Culture. (2-2) Cr. 3. Alt. F., offered 1973. A study of nut culture and production with emphasis on the black walnut, Carpathian walnut, pecan, chestnut, minor species and their hybrids. Special attention given to the dual role of hardwood and food crop production. Lens emphasis is on improvement of their systematic, classification, and evaluation of nut crops, including field trips to acquaint the student with orchard and hardwood production practices.

344. "Annual" Herbaceous Ornamental Plants. (3-0) Cr. 3. F. Prerequisite: 244. Nomenclature, derivation, development, and classification of annuals, biennials, subterranean and herbaceous perennials of ornamental importance in landscape planting.

346. Perennial Herbaceous Ornamental Plants. (3-0) Cr. 2. W. Prerequisite: 244. Growth characteristics of hardy perennial herbaceous ornamental plants. Emphasis upon environmental relationships and environment modification requisite to successful usage and the diagnosis and treatment of management problems.

401, 403, 405. Seminar. (1-0) Cr. 1 each.

413. Turfgrass Science. (Agron 413) (3-0) Cr. 3. Alt. S., offered 1975. Prerequisite: 314, Bot 310. The grass plant: structure, growth, and physiology in relation to the physical (soil, water, light, fertility) and biological (soil microorganisms and pathogens) environment.


487. Horticultural Technology. (3-0) Cr. 3. W., offered 1974. Prerequisite: Bot 310, Agron 354, and permission of instructor. Application of new technology to the production and handling of horticultural crops, including current aspects of soil fertility, variety development, post-harvest physiology, and mechanization.


490. Special Problems. Cr. arr. Prerequisite: Ten credits in horticulture and junior standing.

Courses Primarily for Graduate Students, major or minor, open to qualified undergraduates

501. Horticultural Food Crops. (2-2) Cr. 3. Alt. F., offered 1974. Prerequisite: 3 cr. in plant physiology or biochemistry. Comparative classification of fruits and vegetables based upon physiological, morphological, and cytogenetical similarities and differences; their horticultural use as related to these factors.

511. Horticultural Science. (3-0) Cr. 3. Alt. W., offered 1975. Prerequisite: Bot 310. The physiological bases for horticultural techniques or practices and the effect of environment in modifying these techniques.

512. Genetics and Breeding of Horticultural Plants. (3-0) Cr. 3. Alt. W., offered 1974. Prerequisite: Gen 340. A study of genetic systems and breeding techniques or methods that are of particular value to the improvement of horticultural plants.

590. Special Topics. Cr. arr. Prerequisite: A major or minor in horticulture.

604. Graduate Seminar. Cr. 1 each time elected. F.W.S.
621. Current Topics in Obstetrics. Cr. 2. Offered as arr. Prerequisite: Bot 511, 512, 513; Gen 401. Review and discussion of current literature and problems concerning the genetics, physiology, and culture of vegetables.

622. Current Topics in Pomology. Cr. 2. W. Prerequisite: Six cr. in plant physiology. Review and evaluation of current investigations on fruit breeding, physiology, mechanization, handling, and storage.

624. Physiology of Horticultural Plants. Cr. 3. Alt. S. 1974. Prerequisite: Botany 513, permission of instructor. Application of plant physiology to the problems of sexual and asexual propagation, dormancy, and fruit development.

698. Research. Cr. 1 to 11.

Housing
Martin D. Gehner, Chairman, Advisory Committee
Advisory Committee: Thomas A. Barton, Margaret I. Liston, Clair B. Watson.

Work in housing is offered for the degrees Master of Architecture, Master of Landscape Architecture, Master of Arts or Master of Science as appropriate in the following cooperating departments or major areas: Applied Art, Architecture, Family Environment, Landscape Architecture or Town and Regional Planning.

A student in housing will major in one of the cooperating departments and will develop a program for study under the guidance of a committee nominated by the advisory committee and appointed by the dean of the Graduate College.

The major professor will be in the cooperative department in which the student majors. The degree will be in the major department with emphasis on housing.


*Graduate credit not available to majors in this department.

Hygiene
Gail McClure Proffitt, Head of Department
Assistant Professor: Murphy.

Undergraduate Study

For the Student Health Service of the Department of Hygiene, see Hygiene.

The Department of Hygiene offers opportunities for learning experiences in the general areas of personal health, community health, emergency health care, school health, and individual research in the broad field of health as it is viewed in the three-dimensional aspects of physical, mental, and social well-being.

Personal health education, community health, and emergency health care courses are offered to students in any major, at any level.

School health is offered primarily for those who plan to teach health; e.g., physical education, general education, home economics, child development, family environment, biology, food and nutrition, zoology, and sociology.

Special topics are offered for seniors and graduate students in any major who are interested in doing individual research in a special area of health.

Courses Primarily for Undergraduate Students

104. Personal Health Education. (3-0) Cr. 2. F.W. Murphy. Physical, mental, and social aspects of health as a basis for understanding and preventing health problems.

105. Emergency Health Care. (0-2) Cr. 1. F.W. Murphy. Discussion and application of the basic techniques of administering first aid.

204. School Health. (3-0) Cr. 3. F.W.S.S. Prerequisite: 104, junior classification, admission to teacher certification program. Murphy. Topics such as health education, services, and screening; teaching methods; relationship between school and community.

490. Special Topics. Cr. var. F.W.S.S. Prerequisite: Senior or graduate classification. Murphy.

Immunobiology

Work is offered for the degrees Master of Science and Doctor of Philosophy with major in immunobiology under a cooperative arrangement with the departments of Agronomy, Bacteriology, Food and Nutrition, Genetics, Veterinary Microbiology and Pre-
ventive Medicine, Veterinary Pathology, and Zoology. Facilities exist in several departments for fundamental research in such areas as immunogenetics, physiology of antibody formation, immunofluorescence microscopy, immunochimistry, immunocytoology, immunopathology, immunoparasitology, microbial immunology, and serology.

A student majoring in immunobiology will choose a major professor from the graduate faculty membership of cooperating departments and will develop a suitable program of study under the guidance of a committee nominated by the administrative department head, approved by the immunobiology advisory committee and appointed by the dean of the Graduate College. For administrative purposes the student will be assigned to the department of the major professor.

Students desiring to do graduate work with a major in immunobiology should have a bachelor's degree or equivalent in one of the areas related to the cooperating departments listed above and should qualify for admission to one of these departments. A strong background in biological sciences is desirable, including work in immunology, genetics, and biochemistry. Students who do not have these prerequisites should plan to complete them in addition to the regular course requirements for the advanced degree.

Immunobiology majors should include in their program of study a core of courses chosen from those listed below and comprising the basic program in immunobiology. Formal courses in biochemistry and statistics are recommended. The following courses are also appropriate for inclusion in the program:

- Bact 509, 601, 615, 645, 660, 678
- B & B 574, 575
- C Bio 527, 528
- Gen 605, 615
- Stat 411
- VMPRM 526, 625
- V Pa 653
- Zool 529

Courses for Graduate Students, major or minor

690. Serology. (VMPRM 520) See Veterinary Microbiology.

546. Immunogenetics. (Gen 546) See Genetics.

575. Immunology. (Bact 575) See Bacteriology.

690. Molecular Genetics. (Gen 610) See Genetics.

623. Medical Immunology. (VMPRM 623) See Veterinary Microbiology.

675. Advanced Immunology. (Bact 675) See Bacteriology.

690. Special Topics. Cr. arr. Offered on request with approval of advisory committee. Prerequisite: Twelve credits in immunobiology, permission of instructor. Experimental methods applied in subdisciplines of immunobiology:

A. Immunochimistry.
B. Immunocytoology.
C. Immunogenetics.
D. Immunologic Disease.
E. Immunoparasitology.

695. Seminar. (1-0) Cr. 1. F.S. Prerequisite: Permission of instructor. Kasabia.

Industrial Administration

W.H. Thompson, Chairman of the Department

Professors: Baumel, Brown, Hoover, Schramper, Shadle, Zober.

Associate Professor: Handy.

Assistant Professors: Aitchison, Collins, Coppett, Crockett, Dill, Elvik, Harris, Johnson, Kinker, Murphy, Powers, Senatra, Sharp, Voorhees.

Instructors: Hollingshead, Magill, Mazzitelli.

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 preparation for those who are interested in business oriented positions in industry and government. Each student is required to complete a program which includes a core of basic business courses and to select an option from one of the following areas: accounting, finance, marketing, transportation, physical distribution, and general business. A prelaw program of study is offered by the department. The departments of Economics, Industrial Engineering, Psychology and Sociology offer supplementary instruction in the areas of industrial relations, employer-employee relations, production management, and personnel supervision.

Students majoring in Industrial Administration will be required to complete the following courses in the group requirements of the College of Sciences and Humanities:

- English 104, 105, and 414; Speech 211; Library 160; either Engl 404 or an additional course in speech.
- Mathematics 150X and 151X; Statistics 127, 327; Computer Science—one course.
- Economics 241 and 242 plus two additional courses in Economics.

Interdepartmental programs are jointly offered by the Industrial Administration Department and (1) Curriculum in Construction Engineering, Department of Civil Engineering, College of Engineering where a program of study is provided for those students interested in the construction industry; (2) Department of Institution Management, College of Home Economics, where a program of study is provided for those students interested in the food service industry; (3) Department of Journalism and Mass Communication, College of Sciences and Humanities, where a program of study is provided for students preparing for positions in advertising, public relations, and similar management positions. For additional information either department head may be consulted.

Graduate Study

Open to students for graduate minor credit only:

425, 440, 443, 444, 454, 463, 464, 467, 470, 480, 481, 490.
Courses Primarily for Undergraduate Students

150. Introduction to Industrial Administration (3-0) Cr. 3. F.W.S.S. Orientation of business to modern society. Junior and senior students must take course on a satisfactory-fail basis.

340. Principles of Marketing (3-0) Cr. 3. F.W.S.S. Prerequisite: Econ 242. Market potential, institutions, functions, commodities, and the marketing mix as they relate to the flow of goods. Macromarketing and microanalysis aspects considered along with behavioral, quantitative, national, and international implications.

350. Business Finance (3-0) Cr. 3. F.W.S.S. Prerequisite: Credit or classification in 385; Econ 242. Introduction to financial management to acquaint students with financial planning, financing, and effective use of funds provided.

355. Real Estate Finance (Con E 355) (3-0) Cr. 3. W. Prerequisite: 350 or Con E 246. Value analysis of real estate forms from the viewpoint of the business user and the professional investor.

358. General Insurance. (3-0) Cr. 3. F.W.S.S. Prerequisite: Econ 242. Risk and risk bearing as applied to individuals and business firms. Insurance and probability. Fundamentals of insurance contracts with special emphasis on life and health, with some attention given to automobile insurance.

360. Principles of Transportation. (3-0) Cr. 3. F.W.S.S. Prerequisite: Econ 242. Historical development and current role of transportation in the United States. Economic problems and public policy pertaining to transportation agencies; emphasis on the railroads.

365. Business Law I (3-0) Cr. 3. F.W.S.S. Fundamental principles of law as applied to business transactions and business relationships. Affords the student an opportunity to appreciate our legal system as an agency of social control as well as to observe good business technique and practice.

366. Business Law II (3-0) Cr. 3. F.W. Prerequisite: 365. Sales and negotiable documents of title; security relationships; credit instruments.

368. Business Organization and Management (3-0) Cr. 3. F.W.S.S. Prerequisite: Credit or classification in Econ 242. Organization of a business firm as a social institution and as a functioning unit within the economic, social, and political environment.

371. Industrial Accounting. (3-0) Cr. 3. F.S. Theory and procedure of general accounting, introductory survey of cost accounting objectives and procedures. A terminal course for engineers not planning further study in accounting. This course does not meet prerequisite for 385 or 490. The department recommends that credit in both 371 and 384 not be applied toward graduation.

384. 385. Principles of Accounting. 384: (3-2) Cr. 4. F.W.S.S.; 385: (3-0) Cr. 3. F.W.S.S. Prerequisite: 385; 384. 384: Introduction to principles and procedures of general accounting; development of accounting reports on an accrual basis, business terminology, managerial control procedures relating to service and retail organizations. The department recommends that credit in both 371 and 384 not be applied toward graduation. 385: Continued development of accounting principles and procedures relating to problems of the corporate entity, measurement and control of costs for a manufacturing business, special analysis.

386. Intermediate Accounting. (3-0) Cr. 3. F.W.S.S. Prerequisite: 385. Procedures and theory related to elements of an income statement and the valuation and control of economic resources presented on a statement of financial position, analysis of current liabilities.


428. Financial Information Systems. (3-0) Cr. 3. F.S. Prerequisite: 385. Analysis of conceptual frameworks underlying the accumulation and processing of business data; development of effective management information systems, internal control techniques, and trends in information systems.

440. Industrial Purchasing. (3-0) Cr. 3. F.P. Prerequisite: 340. The purchasing function, management, purchase of optimum quantity, standardization, quality control, store control, purchasing research, and computer applications.

443. Marketing Management. (3-0) Cr. 3. F.W. Prerequisite: 440. Marketing decisions with emphasis on pricing, advertising, personal selling, product development, and channels of distribution. Cases and computer games employed.

444. Marketing Research. (4-0) Cr. 4. W.S. Prerequisite: 443. Problem formulation, research design, questionnaire construction, sampling and interviewing of consumers and businessmen. Marketing research techniques.

446. Marketing Seminar. (3-0) Cr. 3. S. Prerequisite: 444. Analysis of current problems in marketing with particular emphasis on new theoretical and methodological techniques of solving these problems.

447. Behavioral Approach to Marketing. (3-0) Cr. 3. W. Prerequisite: 440. Application of concepts and methods of the behavioral sciences to marketing management decision making.

452. Advanced Business Finance. (3-0) Cr. 3. W. Prerequisite: 350. Allocation of funds within a firm: capital budgeting, mergers, consolidations, reorganization, and valuation problems in selling a going concern.

454. Principles of Investments. (4-0) Cr. 4. F.W.S.S. Prerequisite: 350. Mechanics of investment and secondary market. Individual and institutional investment in limited-income securities common stocks. Also required is a dictate study of a business and the industry of which it is part.


457. Finance Seminar. (3-0) Cr. 3. S. Prerequisite: 452, 454. Contemporary problems, pertinent topics and current research in the areas of business, finance, investment, and investment analysis. Broad reading and individual investigation of specific financial problems and policies required.

459. Property and Casualty Insurance. (3-0) Cr. 3. Alt. S, offered 1975. Prerequisite: 385. Appraisal of property and casualty risks of individual and business organizations. Underwriting of risks. Study of case problems which are intended to develop an understanding of property and casualty insurance programming.

460. Physical Distribution and Traffic Management. (3-0) Cr. 3. F.W.S.S. Prerequisite: 380. Distribution management integrating traffic through cooperative functions of material handling, inventory control, warehousing, and facility location. Traffic organization, functions of carrier selection, determination of rates, classification, routing, and carrier liability. Field trips.


Industrial Education

William D. Wolansky, Professor in Charge

Professors: Carver, Wolansky.

Associate Professors: Diedrick, Parks, Schwenk, Sherick, Wiener.

Assistant Professors: Bell, Bortz, Croy, DuVall, Hulle, Riley, Sarchett, Wenig.

Instructors: Muench, Weber.

Undergraduate Study

For the undergraduate curriculum in industrial education leading to the degree Bachelor of Science, see College of Education, Curricula.

The industrial education curriculum provides essential preparation for those who have a strong aptitude and interest in industrial education teaching and industrial option fields. The individual is afforded the opportunity to pursue a program leading to a position in industry or to certification to teach in junior, senior high schools, and post-secondary schools. In the teaching option, the student must apply for admission to the teacher education committee in industrial education, and the Academic Standards Committee, College of Education. For admission and certification requirements, see College of Education.

Safety and Driver Education. Students interested in obtaining a certificate to teach Safety and Driver Education in secondary schools will enroll in those courses in industrial education designed to meet approval requirements. For the list of those courses, see College of Education, Curricula.

Graduate Study

Industrial education offers work for the degrees Master of Science, Master of Education, and Doctor of Philosophy with major in industrial education, and minor work for students taking major work in other departments. Within the industrial education major, a student may specialize in vocational-technical education or industrial arts.

Prerequisite to major graduate work is preparation substantively equivalent to the completion of the undergraduate curriculum in industrial education and adequate proof that the student ranks above average in scholastic ability and promise of professional competency.

There is no language requirement for the degrees Master of Science or Master of Education. A satisfactory reading knowledge of two languages selected from French, German, Russian, or Spanish is required of doctoral candidates. At the discretion of the student's graduate program committee, the foreign language requirement may be met by: (1) demonstrating a satisfactory reading knowledge of two of the languages named; (2) demonstrating a significantly higher degree of competence in one of the named languages; (3) substituting two years of undergraduate study in the language with a B average for one of the above languages; or (4) substituting...
INDUSTRIAL EDUCATION

9 quarter credits of graduate work in addition to the minimum Ph.D. requirements in approved areas for one language or 18 credits for two languages. Students whose native language is not English may substitute competence in English for one of the languages.

Course for Noncollegiate Students

18. Driver Education. (0-2) Cr. O. F.W.S.S.S. For those learning to drive an automobile. See Fees and Expenses.

Courses Primarily for Undergraduate Students

105. Technology and Application of Finishing Materials. (2-4) Cr. 3. F. A technical approach to finishing materials and techniques used in schools and industries. Testing and evaluating finishes, experimentation, and introductory research.

106. Exploration and Fundamental Fabrication of Wood. (2-4) Cr. 3. W. Prerequisite: 105. Introduction to hand tools, basic machines, pattern making, home construction, and wood technology in current practice.

110. Introduction to Industrial Education. (3-0) Cr. 3. F.W.S. Qualification, opportunities, preparation, and duties of workers in industrial arts, vocational industrial education, and industry.

121. Drafting I. (2-4) Cr. 3. F.W. Lettering; principles and fundamentals of drafting, including techniques, care and use of equipment, sketching, orthographic projection, pictorial drawing, drawing reproduction, topographical drawing, and architectural drafting.

122. Drafting II. (2-4) Cr. 3. W.S. Prerequisite: 121. Continuation of I Ed 121. Emphasis on detail and assembly drawing, fasteners, dimensioning, and surface development.

123. Drafting III. (2-4) Cr. 3. F.S. Prerequisite: 122. This course is a continuation of I Ed 122. Emphasis on machine drafting, rendering, basic tool design, and an introduction to electrical drafting.

125. Advanced Techniques of Wood Fabrication. (2-4) Cr. 3. S.S.S. Prerequisite: 106. Basic principles and practices involved in the use of power woodworking machines and their application to furniture and cabinet making.

216. Problems of Human Conservation. (3-0) Cr. 3. F. Prerequisite: Psych 10. L Survey of highway, industrial, school, farm and home safety, and safety organizations. Principles of accident prevention, individual and group responsibilities.

220. Industrial Arts Design. (3-0) Cr. 3. F.W.S. Application of fundamental principles of design to the field of industrial education. Principles of design, design evaluation, redesign of existing articles, designing for industrial education activities.

230. Ornamental Metal Design and Processes. (0-6) Cr. 3. W. Principles and practices involved in the use of ferrous and nonferrous metals for construction of ornamental projects and teaching aids. Such operations as spinning, tooling, etching, annealing, and wrought iron work.

232. Sheet Metal Fabrication. (0-4) Cr. 3. F.S. Principles, concepts, and practices involved in the use of sheet metal tools, equipment and materials, forming and fabrication, layout techniques.

234. Basic Metal Processes. (0-6) Cr. 3. F.W.S. Principles and practices of bench metalwork: layout, sawing, chiseling, filing, drilling, threading, hardening, tempering, casting.

238. Machine Metals I. (2-4) Cr. 3. F.W.S. Prerequisite: 234. General machine tool operation. Emphasis on precision measuring instruments and technical information as applied to industrial education.

251. Electricity I. (0-6) Cr. 3. F.W.S. Fundamental principles and practices in teaching of direct current electricity in industrial education. The development of experiments, projects, and teaching aids for the secondary school industrial education electricity program.

253. Electricity II. (0-6) Cr. 3. F.W.S. Prerequisite: 251. Fundamental principles and practices in the teaching of alternating current electricity in industrial education. Practical problems in power distribution and use of test equipment. The development of experiments, projects, and teaching aids for the secondary school industrial education electricity program.

280. Power Mechanics: An Introduction. (3-0) Cr. 3. F.W.S.S.S. A brief study of the sources of power, application of power, power-producing and control devices, research and development of power.

281. Power Mechanics: Internal Combustion Engines. (2-4) Cr. 3. F.W.S.S. Prerequisite: 280. Familiarization with reciprocating and reaction engines with emphasis on two- and four-stroke cycle reciprocating engines. Use of tools and equipment for small engine overhaul and tune-up.

282. Power Mechanics: The Automobile. (3-0) Cr. 3. F.W.S.S. Prerequisite: 281. General introduction to the automotive production and service industry, and the automobile itself including engine, chassis, and body.


308. Modern Materials: Design and Construction. (0-6) Cr. 3. F.W. Prerequisite: 105, 106, 258. Advanced design and construction as applied to furniture, cabinet making, recording equipment, and specialized items.

310. School Laboratory Safety. (3-0) Cr. 3. F.S. Prerequisite: Junior classification. Analysis of accidents and accident prevention in the secondary school industrial education laboratory. Methods of initiating an effective safety program.

318. Theory and Principles of Driver Education. (3-4) Cr. 5. W. Prerequisite: 218, 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.

317. Practices of Driver Education. Cr. 1 to 2 each time elected, no more than 4 total. Prerequisite: 316, Iowa driver's license, permission of instructor. Organization of, and experience with, both classroom and behind-the-wheel phases of driver education, including range, lesson plans, films, scheduling, and testing techniques.

324. Architectural Drafting for Industrial Education Teachers. (2-4) Cr. 3. S. Prerequisite: Nine credits in drafting. Emphasis on the design and development of components of plans. Content is directed toward the teaching of secondary and post-high school architectural drafting courses.

338. Machine Metals II. (2-4) Cr. 3. F.W.S. Prerequisite: 238. General machine tool operation with emphasis on advanced set-ups on machine tools, including precision grinding and measurements. Related technical information as applied to the advanced operations and setups.
352. Electricity III. (0-6) Cr. 3. W. Prerequisite: 253. Basic principles and practices involved in electric motor, generator, and appliance construction; motor rewind and electrical appliance repair as applied in industrial education laboratory work.

357. Electronics I. (0-6) Cr. 3. F.S. Prerequisite: 253. Basic principles of radio construction, service, and repair as applied to the secondary school industrial education electronics program. Use of the oscilloscope, signal generator, signal tracer, and other test equipment used in radio.

361. Power Mechanics; Engine Overhaul Procedures. (0-6) Cr. 3. F.W.S. Prerequisite: 262. Automobile engine overhaul procedures and techniques, including proper use of tools, equipment, and manufacturers' manuals; adjustments and measurements; development of supplementary instructional materials.

364. Power Mechanics; Suspension and Braking Systems. (0-6) Cr. 3. F.W.S. Prerequisite: 262. A study of automobile suspension, braking, and power transmission systems; familiarization by work on representative models.

368. Lower Mechanics; Tune-up and Electrical Service. (0-6) Cr. 3. F.W.S. Prerequisite: 262. Automobile engine tune-up and electrical service. Theory of the automobile electrical and fuel systems. Application of theory in troubleshooting and repairing. Developing and presenting instructional materials and techniques.

370. Introduction to Industrial Plastics. (0-6) Cr. 3. F.W.S. Prerequisite: 106; Chem 140 and 140L, or 141 and 141L. Technology of plastic materials and production processes. Principles of thermoforming, compression, transfer, injection, and rotational molding.

90. Care of Equipment. (0-6) Cr. 2 or 3. F.W.S. Prerequisite: Industrial education major, junior standing. Techniques and methods involved in maintenance, repair, and testing of shop tools and machinery.

400. Cooperative Work Experience. Cr. R; Required of industrial education cooperative students. Prerequisite: Permission of department head. Students must register for this course prior to beginning each period of work.

410. Facility Planning and Organization. (3-0) Cr. 3. F.W.S. Planning of school shops and industrial facilities, selection and location of equipment; estimate of cost. Trips to secondary schools and industries.

415. Methods of Teaching Industrial Arts. (3-0) Cr. 3. F.S. Prerequisite: Educ 305A. Methods and techniques of teaching industrial arts; objectives, organization of subject matter, relationships, and evaluation. Field trips to schools. Preteaching laboratory experiences including microteaching.

417. Observation and Supervised Student Teaching in Industrial Education. Cr. 3 to 12. F.W.S. Prerequisite: 415. Observation and supervised teaching in public schools.

418. Multiple Car Range Techniques. (0-2 to 6) Cr. 1 to 2 each time taken, maximum of 3 credits. F.W.S.S. Prerequisite: Three credits in 317; permission of instructor. Schwenk. Organization of and experience with the multiple-car approach to teaching driver education. Internship period arranged with high school programs to provide for observation and experience under actual conditions.

419. Simulation Techniques. (0-2 to 6) Cr. 1 to 2 each time taken, maximum of 3 credits. F.W.S.S. Prerequisite: Two credits in 317; permission of instructor. Schwenk. Organization of and experience with simulation as a teaching phase in driver education. Internship period arranged with high school programs to provide for observation and experience under actual conditions.

450. Electronics II. (1-6) Cr. 3. F.W.S. Prerequisite: 357. Basic television construction, service, and repair. Use of the oscilloscope, vacuum tube-volt-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.


491. Evaluation in Vocational Technical Education. (3-0) Cr. 3. F.S. Prerequisite: Permission of instructor. Evaluation principles and practices related to student, instructional materials and program assessment. Performance testing and evaluation techniques applicable to improving instruction in vocational technical education.

Courses Primarily for Graduate Students, major or minor, open to qualified undergraduates


510. Technique of Teaching Vocational and Technical Education. (3-0) Cr. 3. F.W.S. Prerequisite: Educ 428. Teaching processes, methods of presentation and testing, lesson planning, and organization of instruction.


516. Trends in Vocational-Technical Education. (3-0) Cr. 3. SS. Prerequisite: Nine credits in industrial education. Brief review of the development of vocational and technical education. A study of the most recent trends in various types of schools offering vocational-technical education with respect to curriculum, qualifications and training of instructors, administration of program, requirements for program certification, and the developing ratio of technical, related, and general education within the curriculum.

518. Problems in Industrial Education. (3-0) Cr. 3. SS. Prerequisite: 415. Initiating programs; program organization and development; purchasing materials, supplies, and equipment; facility planning and utilization; writing specifications; program evaluation; and other related problems.


524. Conference-Leading Techniques. (6-0) Cr. 3. SS. Prerequisite: 510. Study and practice of conference procedures and techniques as applied to teaching and advisory committee functions.

525. Coordination of Cooperative Education. (3-0) Cr. 3. SS. Prerequisite: 510. Principles of organization, coordination, and administration of cooperative education with business and industry to provide part-time on-the-job training for students.
528. Public Relations for Industrial and Technical Education. (3-0) Cr. 3 SS. Prerequisite: 514. Identifying a plan of public relations for industrial and technical education; analysis of publics that need to be reached; effects of human relations on public relations; criteria for evaluation.

554. Development of Industrial Education. (3-0) Cr. 3 SS. Prerequisite: 514. An evaluation of educational and industrial thought. Historical and philosophical development of industrial education to the present. Trends and implications.

555. Administration and Supervision of Industrial Education. (3-0) Cr. 3 SS. Prerequisite: 417. Carver. Administration, supervision, curriculum development, selection of staff, and public relations. Evaluating administrative and supervisory efforts; program modification. Field trips to schools and industries.

556. Current Issues and Modern Concepts in Industrial Education. (3-0) Cr. 3 SS. Prerequisite: Fifteen credits in industrial education. A critical analysis of industrial education in the evolving role of education. Newer concepts of teaching laboratory work; impact of research and experimentation; implications for curriculum change and program modernization.

557. Organization and Management of the Industrial Education Laboratory. (3-0) Cr. 3 SS. Prerequisite: 410. Carver, Parks. Principles and practices involved in the planning, organization, and management of the school shop and the ability of the school administrator and teacher; basic principles of planning; selection and purchase of machines, tools, equipment, and materials; maintenance, storage, and control of machines, tools, and equipment; managing the shop for effective work.

559. Processes and Systems in American Industry. (3-0) Cr. 3 SS. Prerequisite: Fifteen credits in industrial education. An exploratory study of modern manufacturing industries. Designed to prepare teachers to interpret industry through a better understanding of the facets; management, systems, controls, financing, and personnel.

570. Administration of Accident Prevention Programs. (3-0) Cr. 3 SS. Prerequisite: 316. Effective methods of developing the background and motivation essential to accident prevention at various educational levels.

571. Seminar: Psychology of Safety. (2-0) Cr. 1 S. Prerequisite: Nine credits in psychology and education, permission of instructor. Schwenk. Review of literature in field of safety. Round-table discussions with state and national safety experts and public officials.

590. Special Topics in Industrial Education. Cr. 1 to 5. Prerequisite: Graduate classification in industrial education.
A. Industrial Arts.
B. Vocational-Technical.
C. Curriculum.
D. Evaluation.
E. Administration and Supervision.
F. Instructional Materials.
G. History and Philosophy.
J. Research.
K. Laboratory Problems.
L. Technical Training.
S. Safety Education.
T. Safety, Industrial Education.

593F. Workshop in Industrial Education. Cr. 1 to 5 SS. Prerequisite: Fifteen credits in industrial education. Carver, Parks, Wolansky.

Courses for Graduate Students, major or minor
615. Seminar. Cr. 1 to 3. F.W.S.S. Prerequisite: Permission of instructor.

652. Evaluation in Industrial Education. (3-0) Cr. 3 SS. Prerequisite: 491. Carver, Stephen. Developing basic concepts. Techniques for evaluating student personnel, facilities, programs, staff, and other educational resources.

655. Instructional Materials for Industrial Education. (3-0) Cr. 3 SS. Prerequisite: Educ 305B and fifteen credits in industrial education. Carver, Parks. Examination of new equipment, materials, and techniques in using instructional materials in industrial education teaching.

657. Curriculum Development in Industrial Education. (3-0) Cr. 3 SS. Prerequisite: Fifteen credits in industrial education. Carver. Basic concepts, trends, practices, and factors influencing curriculum development; techniques, organization, and procedures; the course of study and its development in a given curriculum pattern.

Industrial Engineering
Joseph K. Walkup, Head of Department
Professors: Cowles, David, Griffen, Hempstead, Hilliard, Jaeger, Kleinschmidt, McRoberts, Moore, Gerald Smith, Squires, Vaughn.
Associate Professors: Ashour, Berger, Even, Montag, Clifford Smith, Tamashunas, Watkins.
Assistant Professors: Barta, Grant, Harmison, Hendricks, Lamp, Love, Meeks, Mohr, Sjobakken.
Instructors: Park, Thiele.

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 people, 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 government service.
The curriculum includes in addition to the fundamental engineering sciences, a carefully selected sequence of courses in electrical engineering, mechanical engineering, mechanics, industrial administration, and industrial engineering. Limited opportunities through elective courses are available for further study in other fields of engineering or management.

A five-year cooperative work-study program is available in the Industrial Engineering Department. See Cooperative Programs, College of Engineering.

Graduate Study

The department offers work for the degree Master of Engineering and Master of Science with majors in industrial engineering and in engineering valuation, and for the degree Doctor of Philosophy with major in engineering valuation, and minor work to students taking work in other departments. The department also participates in the interdepartmental program in industrial relations. (See Industrial Relations.)

Prerequisite to major graduate work is the completion of a curriculum substantially equivalent to that required of undergraduate students in engineering at this institution.

Competence in a foreign language is required for the Master of Science and the Doctor of Philosophy degrees. (A score of 400 in the Educational Testing Service examination in French, German, Italian, Russian, or Spanish meets this requirement.) For the Master of Science degree the candidate’s committee may recommend the substitution of an alternative tool of research for the language requirement. Normally, this will be six credits of mathematics, statistics, or computer science courses available for graduate credit, minor only. There is no foreign language requirement for the degree Master of Engineering.

Open to graduate students for minor credit only: 312, 313, 351, 404, 407, 416, 421, 423, 424, 425, 426, 441, 442, 443, 448, 461, 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 both in course and in college environments.

104. Engineering Problems. (1-2) Cr. 1. F.W. Applications of algebra; development of computing skills and orderly methods of solving problems; engineering forms and standards. Uses of slide rule, logarithms, graphs, and tables.


108. Methods of Engineering Computation. (0-3) Cr. 1. F.W. Prerequisite: Credit or classification in Math 120 or 130. 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: Three credits of mathematics. Engineering students required to have credit in 105 or 108. Elementary programming techniques including the use of interpretive routines. Fundamentals in and applications of high-speed and digital computers including laboratory exercises on the computing center equipment.

250. Introduction to Industrial Engineering. (4-0) Cr. 4. F.W. Prerequisite: Math 120 or 130. Introduction to the design and control of production systems. Includes such industrial engineering activities as engineering economy, plant location and layout, work design and measurement, production and inventory control, critical path scheduling, and statistical quality control.

273. Methods Engineering and Work Measurement. (3-2) Cr. 4. W.S. Prerequisite: 250. Principles and practice in modern economy, time study, and other approaches to work measurement; micromotion analysis, memomotion, and random sampling 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. Required of all third-quarter sophomore students. Required of senior college technical students in the first quarter after transfer to the Industrial Engineering Department.

304. Analysis for Engineering Economy. (3-0) Cr. 3. F.W. Engineering/managerial analysis of the economic aspects of public and private project proposals. Emphasis involving the expenditure of capital funds. Alternative sources of funding; time value of money; methods of evaluating alternative projects.

312, 313. Industrial Operations Research. (4-0) Cr. 4 each. 312: F.W.; 313: W.S. Prerequisite: 312: Math 205; 313: Stat 312, Stat 341. History and growth of operations research. The development of mathematical concepts and models concerned with engineering and management decisions. Singult, Chandy, and Dantzig models; e.g., linear programming, inventory theory, game theory, network analysis theory, and other deterministic and stochastic models.

351. Industrial Organization. (3-0) Cr. 3. F.W. 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. Prerequisite: 250 or 361; Stat 342. Adaptation and application of mathematical and statistical techniques to the analysis of problems of an engineering nature. Interpretation of the problems in physical terms.

392. Seminar. (1-0) Cr. R; W.

393. Industrial Inspection Trip. Cr. R; S. Prerequisite: Junior industrial engineering classification. One week spent in industrial centers visiting and inspecting industrial plants.

395. Summer Work. Cr. 3 each. Prerequisite: Advance approval of department head. Approved summer work in industrial plants. Not acceptable as an industrial engineering elective, management elective for industrial engineering, or engineering operations majors.

404. Engineering Economy. (2-2 or 3-0) Cr. 3. F.W. Prerequisite: Econ 242, 1 Ad 371. Application of fundamentals of economics to engineering alternatives in planning, developing, and managing industrial projects.

407. Engineering Valuation. (3-0) Cr. 3. F.W. Prerequisite: Econ 241, 3 credits of accounting. Concepts of value, original cost, and reproduction cost, property records, methods of estimating depreciation for valuation and accounting; intangible values, cost values, earning values, rate base, and valuation for taxation, rates, financing, insurance, and sales.
416. Production Analysis. (3-0) Cr. 3. S. Prerequisite: 313. Specialized mathematical techniques applied to industrial production management.

420. Engineering Sales. (3-0) Cr. 3. S. Prerequisite: 304, 480. Concepts involved with selling technical goods and services. Application of legal, economic, and ethical principles involved in the preparation of specifications, bids, and contracts.

421. Safety Engineering. (3-0 or 3-3) Cr. 3 or 4. F.S. Prerequisite: 250 or 351. Principles of accident prevention in industry; training for and selling safety. Safe machine design and guarding. Industrial compensation and safety legislation.

423. Job Compensation. (2-3) Cr. 3. F. Prerequisite: 250 or 351. Study of the principal pressures and their influence on forms and levels of job compensation.

424, 425. Human Resource Management I, II. 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 approaches to their solution utilizing behavioral science concepts. Emphasizes the organization, motivation and management of human resources, and principles and techniques of selection and placement, personal development and evaluation, and wage and salary administration.

426. Organization Development. (2-2) Cr. 3. S. Prerequisite: 425. Advanced study of current organization development techniques with emphasis on the effective utilization of human resources. Group dynamics, employee training and development, and personnel evaluation and emphasis.


442. Industrial Engineering Design II. (3-4) Cr. 5. W.S. Prerequisite: 313, 441. The development of organization charts and standard crews; the determination and the design of records of performance to be used in the administrative control of a typical manufacturing enterprise.

443. Industrial Engineering Design III. (2-2) Cr. 3. S. Prerequisite: Credit or classification in 442. The development and application of inventory records, load charts, production orders, schedules, production reports, progress reports and control reports to a manufacturing problem in such a manner as to keep a continuous comparison between planned and actual results.

448. Industrial Dynamics. (2-2) Cr. 3. Prerequisite: 351, 404. Information-feedback characteristics of industrial systems; interaction of organization structure, policies, and time delays in the success of an enterprise; relationships between flow of information, money, materials, people, and equipment, and organization or industry. Model building and computer simulation are utilized.

461. Industrial Decision Theory. (3-0) Cr. 3. F. Prerequisite: 304, 361. Decisions under risk and uncertainty, Bayesian decision techniques, and nonlinear utility functions are considered in developing mathematical models of problems in the areas of inventory policy, bidding policy, and purchasing policy.

462. Engineering Inspection. (3-0) Cr. 3. S. Prerequisite: 250 or 351; Stat 105. Inspection of department functions and organization, quality-control procedures, acceptance sampling, and cost studies.

475. Motion and Time Study. (2-3) Cr. 3. W.S. Prerequisite: 351. Principles and methods of motion and time study as employed in industrial operations.

480. Engineering Contracts. (3-0) Cr. 3. F.W.S. Prerequisite: Junior classification. Introduction to jurisprudence, judicial procedure, contract essentials and principles, torts, real property, sales, agency, workmen's compensation, intellectual property.

489. Special Problems. Cr. 1 to 5. Prerequisite: Senior classification, permission of department head. Formulation and solution of theoretical or practical problems which relate to manufacturing, public utility operation, operation of communication systems, or other industrial methods.

491. Seminar. (1-0) Cr. R; F.

Courses Primarily for Graduate Students, major or minor, open to qualified undergraduates

504. Advanced Engineering Economy. Cr. 3 to 5. F.W.S. Prerequisite: 404. Advanced engineering economic analysis; engineering, financial and intangible factors influencing management decision for expenditure of funds. Applications of capital recovery and physical plant replacement theories.

505. Capital Expenditure Programming. (2-0) Cr. 3. S. 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 per cent, and accrued depreciation curves for property groups. Analysis of the effect of growing, declining, and stable properties on depreciation estimates.

509. Engineering Valuation Practice. (2-3) Cr. 3. F.S. Prerequisite: 407. Application of principles of engineering valuation, including field work, preparation and pricing of inventories, valuations for utility rates, security regulations, condemnation, sales, estate settlements, and determining fixed capital costs.


512. Queuing Theory and Applications. (3-0) Cr. 3. Alt. W., offered 1975. Prerequisite: 511. Development and use of mathematical models for the analysis of service systems as applied primarily to industrial situations. Steady state as well as transient systems are considered.

515. Management Science I. (3-0) Cr. 3. Alt. W., offered 1975. Prerequisite: 313. Development of scientific models and analogies applicable to engineering management; investigation of existing mathematical methods; operations research.

516. Management Science II. (3-0) Cr. 3. Alt. S., offered 1975. Prerequisite: 515. Case studies and industrial problems. New methods and theories in management science, and operations research.

518. Digital Simulation Techniques. (3-0) Cr. 3. Alt. F., offered 1974. Prerequisite: 511, Stat 448. Analysis of large scale, mathematically indeterminate management systems by digital computer simulation. Use of Monte Carlo techniques in the simulation, simulation-oriented computer lan-
must be run for valid results, how the experimental design of the simulation model to investigate effects of multiple variables are included. Ability to use the General Purpose System Simulation language (GSS) is developed.

522. Engineering Aspects of Wage Determination. (2-3 or 6) Cr. 3 or 4. S. Prerequisite: 423. Critical survey of wage programs founded on job evaluation; merit rating, wage incentives, basic hourly wage curve, salary classifications, and administrative programs.

527. Dynamics of Industrial Organizations. (2-2) Cr. 3. W. Prerequisite: 425. An advanced study of relevant and current behavioral science research offering insight and understanding regarding the behavior of industrial organizations. Consideration will be given to applying this knowledge and information to the development of vibrant, viable, and socially effective work organizations.


545. Advanced Industrial Engineering Design, Cr. 3 to 5 each time elected. F.W.S. Prerequisite: 441. Planning and controlling the manufacturing plant. Theory of facilities selection and layout; balancing operations and schedules; design of the manufacturing plant; structure of the organization and system. Control techniques, budgets, and realization comparison.

551. Industrial Engineering Concepts, Cr. 3 to 5. F. Prerequisite: 250 or 351; 450, Econ 424. Development in depth of theoretical and practical concepts of current industrial engineering practice.

552. Industrial Organization Theory. (3-0) Cr. 3. S. Prerequisite: 551. Examination of theories of organization with the purpose of explaining, predicting, and influencing organization behavior. Requirements for design and control of industrial organizations and their components.

571. Theory and Principles of Work-Time Relationships. (2-3 or 3-6) Cr. 3 or 5. S. Prerequisite: 441. Evaluation of time-study systems using predetermined elemental time standards; comparison with stop-wake time study. Applications to industrial situation. Analysis of current literature.

581. Legal Aspects of Engineering Administration. (3-0) Cr. 3. F. Prerequisite: 250 or 351, and 460 or I Ad 365A. Engineering management contacts with public administrators and administrative law.

582. Taxation Aspects of Engineering Administration. (3-0) Cr. 3. W. Prerequisite: 581, I Ad 371. Concepts of 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: 450 or I Ad 365A desirable. Management problems concerning patents, trademarks, franchises, copyrights, and royalties.

590. Special Topics. Cr. 1 to 5 each time elected.

A. Management problems in engineering valuation and depreciation.
B. Management problems in personnel.
C. Management problems in industrial engineering.
D. Management problems in regulated industries.

Courses for Graduate Students, major or minor

608. Depreciation Accounting. Cr. 2 to 6 each time elected. F.S. Prerequisite: 507. Unit and group methods of accounting for depreciation; reserve requirements; ad-

justment 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 age problems; shop committees; housing conditions, and industrial relations.

681. Court and Commission Practice, Cr. 2 to 6 each time elected. W.S. Prerequisite: 681A: 581, 608; 681B: 581.

A. Utility rates, property valuation, and depreciation.
B. Legal relations in industry.

690. Seminar. Cr. R: F.W.S.

699. Research. Cr. 1 to 5.

A. Industrial Engineering Research.
B. Engineering Valuation Research.

Industrial Relations

Harold W. Davey, Chairman of Advisory Committee

Advisory Committee: Rita Braito, Terry L. Dickinson, Gerald L. Dorfman, Willis J. Goudy, Robert O. Richards, Jr., Clifford E. Smith.

Work is offered for the degree Master of Science with major in industrial relations. This is a multi-disciplinary degree offered under a cooperative arrangement by the departments of Economics, Industrial Engineering, Political Science, Psychology, and Sociology.

Graduate students in industrial relations usually receive their undergraduate background in economics, industrial (business) administration, industrial engineering, political science, psychology, or sociology. Admission is not restricted to students from these majors, however. Students entering industrial relations should have ideally a broad background in the social sciences.

The program in industrial relations is regarded as education for both professional practice and scientific inquiry. Through the Industrial Relations Center and its interdisciplinary faculty, facilities and opportunity exist for research of both a fundamental and applied nature on a variety of problems concerned with the world of people at work.

A student majoring in industrial relations will choose a major professor from the graduate faculty of the cooperating departments, who ordinarily will be a member of the industrial relations advisory committee. The student's program of study will be developed with the guidance of an advisory committee nominated by the major professor, approved by the industrial relations advisory committee and appointed by the dean of the Graduate College. The program of study will include course work from three of the disciplines represented in the industrial relations program.
Each student will select two of the five cooperating disciplines (economics, industrial engineering, political science, psychology, and sociology) as a major field. Approximately two-thirds of the student’s program (including thesis) will comprise the major field. The remainder of the program will include Statistics 401 and other elective courses. Statistics 402 is strongly recommended.

Normally, candidates for the degree Master of Science are required to complete satisfactorily 45 credits of acceptable graduate work including preparation of a thesis. With the approval of the student’s advisory committee, however, candidates may fulfill requirements by completing satisfactorily 54 credits of course work, in which case preparation of a thesis and Statistics 401 are not required. Under this degree program a student will select courses from four of the five cooperating departments. Satisfactory completion of a comprehensive examination is required.

A foreign language is not required.

The verbal and quantitative aptitude tests of the Graduate Record Examination are recommended for all applicants to the industrial relations program.

Courses appropriate for the Master of Science degree are determined by the student’s advisory committee. Recommended courses for graduate students majoring or minorin in industrial relations include: Econ 445, 590, 591, 592, 595; Psych 440, 450, 451, 522, 523, 550, 551, 580, 581; Soc 401, 410, 480, 566, 600, 601, 698A, 698D; IE 424, 425, 426, 448, 475, 480, 522, 571, 581, 590, 624; Pol S 420, 421, 422, 520. See departmental listings for course descriptions and credits.

Graduate Study

The department offers work for the degree Master of Science with major in institution management and minor work to students taking major work in other departments.

Work may be taken for the degree Doctor of Philosophy as a joint major with departments offering work for this degree in home economics, engineering, economics, or other related areas.

The usual prerequisite to major graduate work is the completion of 10 quarter credits in institution management and six in food and nutrition, and fundamental preparation in accounting, chemistry, and bacteriology. The exact requirements will depend upon the field of work the student expects to pursue.

There is no foreign language requirement for the degree Master of Science. A foreign language is not required for the degree Doctor of Philosophy unless skill in a particular foreign language is needed in an individual program of study.

Open to graduate students for minor credit only: 450, 460, 470, 484, 485, 487, 488, 489.

Institution Management

Marjorie M. McKinley, Head of Department

Professors: Augustine.

Associate Professors: Montag.

Assistant Professors: Beattie, Brown, Frederiksen, Hittle, Hostetler, Olsen, Robson, Walsh.

Undergraduate Study

For undergraduate curriculum in institution management leading to the degree Bachelor of Science, see Home Economics, Curricula.

The curriculum in institution management provides professional preparation for men and women interested in managerial positions in institution food service or residence administration. The department offers work for the degree Bachelor of Science with majors in college food and housing administration, hotel and restaurant management, or school food service.

The major in college food and housing administration is planned to provide men and women with a general education plus professional preparation for the management of college and university student unions and residence halls. Basic courses in various aspects of administration are supplemented by laboratory experiences.

The major in hotel and restaurant management provides, in addition to a general education, basic work to prepare men and women for supervisory and executive positions in the hotel and restaurant industry. Principles of business management are presented, as well as fundamentals of food service and housing service.

The major in school food service offers preparation for administering school food service programs in elementary and secondary schools. A general education and basic professional courses pertinent to this field are provided for students who wish to prepare for managing single or multiple school food service systems and to become area and state school food service supervisors or directors. See discussion of institution management curriculum for statement regarding certification for teaching home economics.

Training in large quantity food preparation and service is afforded through the Institution Management Tearoom. The food and house administration departments of the Memorial Union, University residence halls, and other approved establishments offer managerial experience to advanced students. A two- or three-day field trip to businesses related in institution management will be offered alternate years and will be required of majors in the institution management department.
Courses Primarily for Undergraduate Students

287. Introduction to Institution Management. (3-0) Cr. 3. S. Introduction to management concepts and principles as related to general and business use. Orientation to the food and housing service industry. Field trips required.

380. Quantity Food Production Management. (2-6) Cr. 4. F.W.S.S. Prerequisite: P & N 208 or 214. Principles and application of management in quantity food production. Use of appropriate production and service methods and institution equipment. Advance reservation with department head required.

400. Study Tour. Cr. 1. Alt. S., offered 1974. Prerequisite: Junior or senior institution management classification. Study tour of quantity food service and house administration units and related industries.

404. Seminar. (2-0) Cr. 2. S. Prerequisite: Senior classification.


460. Legal Aspects of Hotel and Restaurant Management. (3-0) Cr. 3. Alt. S., offered 1975. Prerequisite: 487, I Ad 365D. Laws relating to the ownership and operation of hotels, restaurants, and similar institutions. The responsibility of management and employees to guests and the public.

470. Quantity Food Production and Service Methods. Cr. arr. S.S. or S.S.S. Prerequisite: A college course in principles of food preparation. Methods of producing food in quantity using institution equipment. Interpretation for teaching nonsupervisory food service workers. Designed to contribute to preparation of teachers of vocational food service courses. Not accepted in lieu of I Mgt 380 for Iowa State institution management and food and nutrition majors.

484. Purchasing and Inventory Management. (3-3) Cr. 4. F.W. Prerequisite: 380 or F & N 303. Principles of buying food and inventory management for various types of quantity food service. Emphasis on specifications and various factors affecting quality. Field trips required.

485. Layout and Equipment. (3-3) Cr. 4. S.S.S. Prerequisite: Credit or classification in 380. Food facilities planning and design; selection of equipment with emphasis on materials, construction, and specifications. Field trips required.

486. Institution Management Experience. A: Cr. arr. F.W.S. S.S.; B: Cr. arr. F.W.S.S.S.; C: Cr. arr. S.; D: Cr. arr. S. Prerequisite: A: 484, 485, 488; C: 488A, 488B, 489. C, D only for students majoring in college food and housing administration. A and B: Food Service Management; C and D: Housing and Social Program Management. Analysis and interpretation of management functions. Emphasis on interpersonal relations. Experience in food and housing departments of Iowa State University, Memorial Union, and approved establishments. A and C: Lecture-discussion. B and D: Laboratory.

487. Organization and Management. (3-4) Cr. 3. W.S.S. Prerequisite: 380. Functions of management; procedures and controls applicable to food service and housing organizations; emphasis on financial management including control of food, labor, and other variable costs.

488. Personnel Management in Institutions. (3-0) Cr. 3. F.S. Prerequisite: 487. Principles of management and personnel organization as applied to food and housing organizations. Principles and practices related to personnel recruitment, selection, training, employee-employer relations, and wage administration. Union and government considerations.

489. House Administration. (2-3) Cr. 3. W. Prerequisite: 485. Senior classification. Management considerations of residence and housekeeping functions in institutions. Selection and maintenance of institutional furnishings and materials, equipment, and supplies. Field trips required.

490. Special Problems. Cr. arr. Prerequisite: Permission of department head.
A. Quantity Food Production.
B. Organization and Management.
C. General.
D. Housing.
H. Honors.

Courses Primarily for Graduate Students, major or minor, open to qualified undergraduates

500 Short Course. Cr. arr.

580. Quantity Food Development. (1-6) Cr. 3. 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.


589. Special Topics and Workshops. Cr. arr. Prerequisite: Permission of department head.
A. Food Service Management.
B. Housing Service Management.
C. General.

Courses for Graduate Students, major or minor


602. Decision Optimization in Institution Management II. (3-0) Cr. 3. S. Prerequisite: Nine quarter credits in institution management including I Mgt 487, permission of department head. Montag. Use of selected quantitative methods of operations research and engineering economy to optimize decisions in institution food and housing service systems.


608. Administration Problems. (1-6) Cr. arr. F.W.S. Prerequisite: 487. McKinley. Consideration of advanced administrative problems. Case studies in food service and housing departments of Iowa State University, Memorial Union, and other institutions.

699. Research.

International Studies

International Studies in the College of Agriculture

Students in agriculture remain in their chosen curriculum and use their electives to meet program requirements for international studies in agriculture. The requirements are as follows:

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<tr>
<th>Credits</th>
<th>Description</th>
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<tbody>
<tr>
<td></td>
<td>Anthropology-Anthro 111</td>
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<tr>
<td></td>
<td>Economics-Econ 308</td>
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<td></td>
<td>Comparative Economic Systems—Econ 411</td>
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<tr>
<td></td>
<td>International Economics—Econ 455</td>
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<td></td>
<td>Agrarian Reform and Economic Development—Econ 512</td>
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</table>

All credits must be in a single language.

International Studies in the College of Engineering

Students in engineering may remain in their chosen curriculum and use their electives to meet program requirements for international studies. Additional requirements include:

<table>
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<tr>
<th>Credits</th>
<th>Description</th>
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<tbody>
<tr>
<td></td>
<td>International Law—Pol S 422</td>
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<td>British and Commonwealth Governments—Pol S 440</td>
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<td>Governments of Western Europe—Pol S 441</td>
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<td>Governments of China and Japan—Pol S 442A</td>
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International Studies in the College of Home Economics

An emphasis in international studies is designed to provide students with a background for participation in government or agency programs, as well as to provide an opportunity to become oriented to national and international affairs as part of the responsibility of citizenship in its broadest sense.

Students in home economics with a concentration in international studies follow a curriculum that includes emphasis in social sciences—history, political science, economics, sociology, anthropology, psychology, and languages—in addition to home economics.

See Home Economics for the specific program. Interested students in home economics should consult Julia F. Anderson for further details.

International Studies Major in the College of Sciences and Humanities

Students wishing to major in international studies in the College of Sciences and Humanities must have a second major, ordinarily in anthropology, economics,
foreign languages, history, journalism, philosophy, political science, or sociology. Students with other major programs may be admitted to the international studies program by the chairman of the International Studies Committee. In addition to fulfilling general education requirements and the major requirements in the discipline chosen, each student majoring in international studies must complete the following program:

A. General Courses in International Studies. Students majoring in anthropology, economics, history, journalism, philosophy, political science, or sociology, must select from the following list four disciplines other than their own and must complete at least six credits in each of the four. Foreign language majors must select at least six credits in each of four of the following disciplines. Courses offered in completion of this requirement must be chosen from those listed under each discipline.

Anthropology:
The Family in Cross-Cultural Perspective—Anthro 313 (3 cr.).
Comparative Studies of World Cultures—Anthro 321 (3 cr.).
Anthropological Perspectives of Religion—Anthro 340 (3 cr.).
Language and Culture—Anthro 400 (3 cr.).
Ethnology of the Old World—Anthro 424 (3 cr.).
Culture Change—Anthro 425 (3 cr.).

Economics:
Comparative Economic Systems—Econ 306 (3 cr.).
Economic Development—Econ 411 (3 cr.).
International Economics—Econ 455 (3 cr.).
International Finance—Econ 456 (3 cr.).

Geography:
World Geography—Geog 201 (3 cr.).
Economic Geography—Geog 322 (3 cr.).
Cultural Geography-European and American—Geog 324 (3 cr.).
Cultural Geography-African, Asian, Australian and Pacific Islands—Geog 325 (3 cr.).

History:
History of United States Foreign Policy—Hist 477A, 477B, 477C (3 cr. each).
Journalism and Mass Communication:
International Communication and the Foreign Press—JL 440 (3 cr.).
Mass Communication in Developing Nations—JL 545 (3 cr.).

Political Science:
Introduction to International Politics—Pol S 251 (3 cr.).
Politics of Developing Areas—Pol S 340 (3 cr.).
International Law—Pol S 422 (3 cr.).
Comparative Foreign Policies—Pol S 452 (3 cr.).
International Organizations—Pol S 453 (3 cr.).
United States Foreign Policy—Pol S 458 (3 cr.).

Sociology:
Introduction to Social Ecology and Population Studies—Soc 304 (3 cr.).
Social Stratification—Soc 350 (3 cr.).
Urban Sociology—Soc 410 (4 cr.).
Societal Change and Development—Soc 411 (3 cr.).
Adoption and Diffusion of Innovations—Soc 415 (3 cr.).

B. Area Studies. The student must complete at least six credits in one of the following groups:

Africa and the Middle East:
Introduction to Africa—D St 204, 205, 206 (3 cr. each).
Politics of the Middle East—Pol S 445 (3 cr.).
Governments of Africa: South of the Sahara—Pol S 446A, 446B (3 cr. each).

Asia:
Introduction to East Asia—D St 207, 208, 209 (3 cr. each).
History of China—Hist 340, 341, 342 (3 cr. each).
Modern Japanese History—Hist 443 (3 cr.).
Religions of Western Asia—Phil 351 (4 cr.).
Religions of Southern and Southeastern Asia—Phil 352 (4 cr.).
Religions of East Asia—Phil 353 (4 cr.).
Governments of China and Japan—Pol S 442A (3 cr.).
Governments of India, Pakistan and Southeast Asia—Pol S 442B (3 cr.).
Asia in World Affairs—Pol S 451 (3 cr.).
Japanese Political Thought and Institutions—Pol S 542 (3 cr.).

Latin America:
Introduction to Latin America—D St 201, 202, 203 (3 cr. each).
Contemporary Latin American Cultures—Anthro 325 (3 cr.).
Native Peoples of Middle and South America—Anthro 325 (3 cr.).
History of Latin America—Hist 350, 351, 352 (3 cr. each).
Spanish and Ibero-American Civilization—FL 359 (3 cr.).
Introduction to Spanish American Literature—FL 464, 465, 466 (3 cr. each).
Latin American Governments—Pol S 443A (3 cr.).
Recent Latin American Politics—Pol S 443B (3 cr.).

Russia:
Russian Civilization—FL 327, 328, 329 (3 cr. each).
History of Russia—Hist 416A, 416B, 416C (3 cr. each).
Journalism and Mass Communication

James W. Schwartz, Head of Department

Professors: Fox, Hamilton, Hivistendahl, Kern, Marvin, Shelley.

Associate Professors: Bailey, Blinn, Crom, Disney, Johnson, Kunerth, Pollard.

Assistant Professors: Boyd, Bratton, Crook, Fassel, Friederich, Laws, Menne, Nelson, Yarbrough.

Instructor: Wechsler.

Undergraduate Study

The department offers work for the degrees Bachelor of Science and Bachelor of Arts with major in journalism and mass communication. A number of professional emphases are available to the student: newspaper journalism, magazine journalism, radio- and TV journalism, advertising, public relations and public information, international communication, and the teaching of journalism. These programs are worked out with the aid of the student’s academic adviser in journalism and vary depending upon the student’s background and experience.

Students in journalism and mass communication enroll in one of four colleges of the university, depending on their area of specialty:

- College of Sciences and Humanities (general journalism and science journalism)
- College of Home Economics (home economics journalism)
- College of Agriculture (agricultural journalism)
- College of Engineering (engineering journalism)

With the exception of general journalism, the basic program is combined with a specialty area within a college. Those in general journalism take essentially a liberal arts program, and support their journalism studies with such subjects as literature, history, political science, psychology, sociology, economics, and philosophy. Either one or two minors or a second major in international relations are required in this curriculum.

Those in the science journalism program concentrate on the physical and biological sciences in preparation for careers in science writing. Home economics journalists take concentrations in food and nutrition, textiles and clothing, applied art, family environment, or child development. Agricultural journalists concentrate in animal science, agronomy, agricultural economics, rural sociology, horticulture, food technology, outdoor recreation, or fish and wildlife biology. Engineering journalists combine their work in journalism with concentrations of engineering subjects. (See appropriate sections of the catalog for specific requirements in these specialty fields.)

All journalism students take a common core of courses in journalism and mass communication. This consists of a minimum of 34 credits of course work in journalism plus 3 credits of 490J, the professional work requirement. Course work includes 101, 201, 202, 203, and at least 12 credits of 300-level courses and 9 credits of 400-level courses in addition to 490J.

Students majoring in other fields who wish to minor in journalism are invited to consult with journalism staff members for a recommended sequence of courses tailored to fit their particular needs and goals.

Graduate Study

The department offers work for the degree of Master of Science with major in journalism and mass communication, and minor work to students
Courses Primarily for Undergraduate Students

101. Introduction to Mass Communication. (2-0) Cr. 2. 
F.W.S.S.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. For freshmen, sophomores, and transfer students.

201, 202, 203. Basic Reporting, Writing, Editing. 201: (2-4) Cr. 4. F.W.S.; 202: (2-4) Cr. 4. F.W.S.; 203: (0-6) Cr. 3. F.W.S. Prerequisite: 201: 101, English 105 or equivalent, some typing proficiency; 202: 201 or equivalent; 203: 202. Observation, organization, writing, and editing of materials for all mass media, with emphasis on common principles and competencies. Sequence moves from simple data gathering and writing techniques through a variety of experiences to investigative reporting and interpretive writing. The final course consists of writing for print or broadcast media.

225. Publicity and Public Relations. (3-0) Cr. 3. F.W.S.S.S. Principles of publicity and public relations. Major and minor functions of publicity and public relations in advertising, journalism, and mass communications. For credit, permission of instructor. A prerequisite of English 101 is required.

238. Print Media Editing and Production. (3-6) Cr. 6. F.W.S. Prerequisite: 203. Writing, editing, editorial planning and decision making for magazines, newspapers, house publications, and similar publications; layout, typography, preparation of copy, production methods.

240C. Telecommunicative Arts. (Sp 430) See Speech and Telecommunicative Arts.

245. Impact of Communication Technology on People and Societies. (3-0) Cr. 3. S. Prerequisite: Permission of instructor. Seminar to study present and potential effects of communications technology on institutions and societies of increasingly sophisticated modes of mass communication; television, computerized publications, rocket transportation, facsimile, radar, microwave, lasers, masers, satellites, etc. Focus on how these may affect men's abilities to solve their daily problems, determine their and their countries' destinies, and understand themselves and their fellow men.

300. Journalism and Literature. (3-0) Cr. 3. F.W.S. Prerequisite: Permission of instructor. A study of the role of literature and the press in the development of American culture and of the influence of literature on the press and vice versa. Emphasis on poetry and fiction with attention to the way in which all forms of literature have contributed to the development of the American press. Credit may not be applied toward the Journalism major.

302. Motion Picture Techniques. (Sp 317) (2-3) Cr. 3. F.W.S. Prerequisite: 317 or equivalent. Basic techniques in sound, shooting, editing, and presenting motion pictures as a means of communication with special stress on the requirements for television.


318. Laboratory in Photojournalism. (0-5) Cr. 3. S. Prerequisite: 317 or equivalent. Opportunity to explore areas of special interest in photography with emphasis on pictorial composition and fine print quality.

337. Print Media Advertising. (3-0) Cr. 3. F.W.S. Prerequisite: 325. Analysis of print media, preparation of radio and television commercials.

340. Radio and Television News Reporting. (3-3) Cr. 4. W. Prerequisite: 203 or 345. Writing, editing, news gathering, preparation of broadcast news and public affairs programs. Field trips.

360. Depth Reporting and Writing. (2-4) Cr. 3. F.S. Prerequisite: 203 or 352. Reporting and writing in depth on current issues and concerns, with opportunity to develop news features, magazine articles, broadcast documentaries, monographs.

370. Print Media Editing and Production. (3-6) Cr. 6. F.W.S. Prerequisite: 203. Writing, editing, editorial planning and decision making for magazines, newspapers, house publications, and similar publications; layout, typography, preparation of copy, production methods.

400C. Telecommunicative Arts. (Sp 430) See Speech and Telecommunicative Arts.

415. Public Opinion and Mass Communication. (3-0) Cr. 3. S. Prerequisite: Nine credits in social science. Major factors influencing public opinion; mass media effects; measuring, evaluating, and reporting public opinion.

417. Pictorial Communication. (3-0) Cr. 3. F.W.S. Prerequisite: Permission of instructor. A study of how pictures communicate by means of subject matter, symbolism, plastic qualities and other elements.

425. Law of Communications (3-0) Cr. 3. F.W.S. Prerequisite: Permission of instructor. Seminar to study present and potential effects of communications technology on institutions and societies of increasingly sophisticated modes of mass communication; television, computerized publications, rocket transportation, facsimile, radar, microwave, lasers, masers, satellites, etc. Focus on how these may affect men's abilities to solve their daily problems, determine their and their countries' destinies, and understand themselves and their fellow men.


440. International Communication and the Foreign Press. (3-0) Cr. 3. F.W.S. Prerequisite: Nine credits in social science. Study of world news communication systems, news-gathering agencies, the role of foreign correspondents, and the factors determining the flow of world news. Comparative analysis of mass media systems in developing countries.

450. Institutional Public Relations. (4-0) Cr. 4. W.S.S.S. Prerequisite: Nine credits in social science. Principles of public relations and its practice in developing countries, education, social welfare, government, and the military services; relation of the mass media to public relations practice.

462. Press Freedom, Responsibility, and Ethics. (3-0) Cr. 3. F.W.S. Prerequisite: Nine credits in social science. 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. F.W.S. Prerequisite: Nine credits in journalism. 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. W.S. Prerequisite: Permission of instructor. A scrutiny of writing and design of publications.
as art as practiced by such eminent journalists as Twain, Hemingway, Crane, Dreiser, Whitman, Mencken; and an inquiry into the problems of the "New Journalism" as practiced by contemporary journalists.

480. The Teaching of High School Journalism. (3-4) Cr. 5. S.S.I. Prerequisite: Junior classification, admission to teacher education program. Seminar on the techniques of teaching high school journalism coordinate with advising high school publications. For the journalism major preparing for high school teaching and for the nonmajor who could expect a journalism course assignment as part of a high school teaching program.

490. Special Problems in Communications. Cr. arr. Prerequisite: Permission of instructor.
A. Broadcasting.
B. Visual/Pictorial.
C. Advertising.
D. Media Management.
E. Law.
F. History.
G. International.
H. Honors.
I. Audiences and Effects.
J. Professional Media Work (3 cr. required).
K. Technology.
L. Agricultural Journalism.
M. Journalism Education.
N. Home Economics Journalism.
O. Public Relations.
P. Contemporary Problems in Journalism.

Courses Primarily for Graduate Students, major or minor, open to qualified undergraduates

501. Theories of Mass Communication. (4-0) Cr. 4. F. Prerequisite: Permission of instructor. Nature of the research process. Relationship of theory, hypotheses, and measurement models. Communication research techniques and study analysis.

502. Mass Communication Research. (4-0) Cr. 4. W. Prerequisite: 501. Examination of major areas of research activity and theoretical development related to the organization, functions, and effects of mass communication.

515. Strategies of Communication and Persuasion. (3-0) Cr. 3. S.S.I. Prerequisite: Permission of instructor. The process of developing professional communication and persuasion strategies, with emphasis on problem definition, behavioral specification of objectives, situation analysis, strategy formulation and justification through application of communication theories and research results.

526. Journalistic Practice for Scholar and Scientist. (1-4) Cr. 3. F. Prerequisite: Permission of instructor. Reporting, writing, and editing for the mass media, with special attention to problems of the scholar and scientist who use the media.

527, 528. Specialized Reporting. (1-4) Cr. 3. 527; W.:
528: S. Prerequisite: 527: 528; 528: 527. Reporting, writing, and editing for the communicator who mediates between scholar, scientist, and various publics.

530. The Press and Society: Interrelationships. (4-0) Cr. 4. F. Prerequisite: Permission of instructor. The press and its functions in a democratic society; conflicts between the press and social institutions; legal, social, and political controls of the press; solutions to conflicts.

545. Mass Communication in Developing Nations. (3-0) Cr. 3. W. Prerequisite: Permission of instructor. Evaluation and comparison of traditional and transitional systems of communication; study of the role of communications in societal growth; development, structure, and functions of systems in Africa, Asia, and Latin America.

550. Special Problems. Cr. arr. Prerequisite: Permission of instructor.

Courses for Graduate Students, major or minor

650. Seminars in Journalism Communication. Cr. 3 each. Offered as demand warrants from following topic list.
A. Broadcasting.
B. Visual/Pictorial.
C. Advertising.
D. Media Management.
E. Communications Law.
F. Communications History.
G. International Communications.
H. Society and Mass Communication.
I. Audiences and Effects.
J. Agricultural Journalism.
K. Teaching Journalism and Mass Communication.
L. Research.

Landscape Architecture

Thomas A. Barton, Head of Department
Professor: Dyas.
Associate Professors: Harvey, Lane, Sinatra.
Assistant Professors: Olson, Roberts.
Instructor: Hightshoe.

Undergraduate Study

For undergraduate curriculum in landscape architecture leading to the degree Bachelor of Science, see College of Agriculture, Curricula.

Landscape architecture is a profession concerned with the quality of land use. It includes analysis of environmental factors and recommendations for preservation, and with other professions, the design, construction, and maintenance of developed land areas. Among the types of land development normally included in professional practice are park and recreation areas, school grounds, institutional grounds, industrial sites, commercial sites, land subdivisions, and residential properties. The scale or scope of such projects varies from broad regional landscape analysis and planning to detailed design.

The curriculum, accredited by the American Society of Landscape Architects, provides the student with an education which, combined with experi-
ence, is necessary for professional registration in several states.

Graduate Study
The department offers work for the degree Master of Landscape Architecture with major in landscape architecture. Minor work is offered to students taking major work in other departments.

The degree Master of Landscape Architecture is granted upon the completion of two years of graduate study with a minimum of 60 credits in residence at Iowa State University.

Satisfactory completion of L A 500, 514, 515, 516, or their equivalents, and the acceptance of a thesis or a terminal project are required for the M.L.A. degree.

Students desiring to major in landscape architecture should present credits substantially equivalent to those secured by undergraduate students in the curriculum in landscape architecture at this institution. The department also participates in the interdepartmental program in housing. (See Housing.)

There is no uniform foreign language requirement for the degree Master of Landscape Architecture. However, a satisfactory reading knowledge of German, French, Russian, or Spanish will be required when specifically recommended by the student’s advisory committee.

Open to graduate students for minor credit only: 404, 411, 412, 413, 420, 436, 445.

Courses Primarily for Undergraduate Students

110. Orientation in Landscape Architecture (1-0) Cr. R; F. Survey of landscape architecture and allied fields.

112. Graphic Communication. (Ur Fl 112) (0-9) Cr. 3. F.W. Introduction to and experimentation with the graphic media used by the landscape architect and urban planner, including instrument drawing, lettering, dimensioning, and freehand sketching.

113. Landscape Perception. (1-9) Cr. S.SSL Understanding and appreciation of form, space, and other visual aspects of the landscape. Sketching and experimentation with land and plant forms; fundamental spatial organization.

201. History of Landscape Architecture I. (30) Cr. 3. W. The development of landscape architecture from antiquity to modern times, with its relation to and influences of allied arts and professions. Lectures, readings, abstracts, and reports.

210. Survey of Landscape Architecture. (3-0) Cr. 3. F.S.S. Survey of the profession of landscape architecture. Design process, history, ecology, planning design, and planning the site, the city, and the region, are explored through lectures, visiting lecturers, movies, and slides.

213. Theory of Landscape Design. (1-9) Cr. 4. F.S. Theory and principles of design are explored in two- and three-dimensional forms. An introduction to functional diagramming relating human use to site considerations is included.

231. Plant Materials I. (1-9) Cr. 4. F. Introduction to study of plant materials as used in landscape design. Emphasis is on trees, shrubs, and woody vines native or introduced to Iowa. Field trips on campus and to nearby parks, woods, and fields; one or more field trips will be off campus.

232. Fundamentals of Planting Design. (1-9) Cr. 4. W. Prerequisite: 231 or Hort 480. Creative problems in the design of outdoor spaces, with emphasis on the selection and arrangement of plant materials. Functional, cultural, and esthetic aspects are considered; includes design analysis, drawing of planting plans, and construction of scale models.

233. Plant Materials II. (1-9) Cr. 4. S. Prerequisite: 231 or Hort 480. Study of trees, shrubs, vines, and herbaceous materials as used in landscape design. Emphasis is on important form, color, and textural aspects of introduced exotic horticultural species and varieties. Field trips on campus and to nearby parks, gardens, and landscape nurseries.

251. Materials and Fundamentals of Construction. (2-6) Cr. 4. W. Prerequisite: C E 211A. An introduction to the landscape architect’s construction materials, methods of construction, grading and earth volume computations, and construction drawings.

311. Master Land Planning. (1-12) Cr. 5. F.S. Prerequisite: 213. Physical design methodology of large scale projects involving mixed land uses. Functional relationships between uses, physiographic, social, economic, and political factors are considered. Field trips.

334. Site Planning and Planting Design. (1-12) Cr. 5. F.W. Prerequisite: 218, 232. Site planning projects involving the location and integration of buildings, roads, parking areas, walks, and plant materials. Development of site plans, and detailed planting plans.

352. Site Planning and Construction. (1-12) Cr. 5. F.W. Prerequisite: 213, 251. Site planning projects involving the location and integration of buildings, roads, parking areas, and walks. Development of site plans, including grading plans, and construction details.

404. Outdoor Recreation in the United States. (3-0) Cr. 3. W. Survey of historical aspects, current problems, and future trends; influence of natural resources. Introduction to planning and selection of sites for recreation use.

411. Land Analysis. (2-9) Cr. 5. F.S. Prerequisite: Junior classification. Analysis of the physical and biological processes of land. Investigations are made of limiting factors and opportunities as these are employed in planning and design for human use. Instruction includes visits to professionals from allied fields.

412. Landscape Evaluation. (1-12) Cr. 5. S. Prerequisite: 411. Interpretation and communication of landscape qualities; sketching, photography; graphic and oral presentation. Field trips.

413. Advanced Landscape Design. (1-12) Cr. 5. S. Prerequisite: 334, 352. Depth study of a comprehensive landscape architectural problem situated within an existing environment. Research, preliminary studies, conferences, and presentation of recommendations. Field trips.

420. Land Impact. (2-9) Cr. 5. W. Prerequisite: 411. The environmental impact of designed actions on the natural systems; define actions which could minimize the impacts and suggest alternative design solutions to the proposed actions.

422. History of Landscape Architecture II. (3-0) Cr. 3. W. Prerequisite: 201. Theories, concepts, and effects of man’s design influence upon his physical environment. Lectures, readings, abstracts, and reports.

436. Advanced Planting Design. (2-9) Cr. 5. W. Prerequisite: 334. Advanced study of planting design.

445. Planning Recreation Systems. (3-0) Cr. 3. S. Prerequisite: 404. Survey of techniques for planning recreation systems at city, county, state, regional, and national levels; criteria for determining location of recreation sites and their distribution.
Courses Primarily for Graduate Students, major or minor, open to qualified undergraduates

500. Seminar (1-0) Cr. 1 F.W.S.

514, 515, 516. Landscape Architecture—Design (0-9) Cr. 3 each F.W.S. Prerequisite: 411. Programming, analysis, synthesis, and presentation phases in urban design, regional design, and recreational design and planning. An exploratory study of innovations in policy and design methods preliminary to preparation of a thesis or a terminal project.

517. Terminal Project Cr. arr. F.W.S. Comprehensive study and original development of a project selected by the student and approved by the department. The completed project must be submitted to and approved by a graduate college faculty committee as evidence of mastery of the principles of landscape architecture.

590. Special Topics Cr. 2 to 5 each time elected. Prerequisite: Permission of instructor.
A. Landscape Design
B. Hanting Design
C. Details of Construction
D. History
E. Resource Analysis
F. Urban Design

Courses for Graduate Students, major or minor

699. Research

Instructors: Cook, David Dowell, Folts, Foreman, Kirk, Kraft, Lee, Marks, Monson, Albert Perdue, Judy Perdue, Peterson, Richardson, Schogren, Shornrock, Snyder, Vondran, Wendell.

Undergraduate Study

The Library offers instruction to increase facility in the independent use of libraries and books.

Graduate Study

The Library offers a series of noncredit seminars to assist graduate students in the use of library resources. The seminars are geared to the five broad disciplines: biological sciences, engineering, humanities, physical sciences, and social sciences. For information and registration refer to the Library Reference staff.

Courses Primarily for Undergraduate Students

160. Library Instruction (1-0) Cr. 1 F.W.S. Use of libraries and books, including a survey of literature of major curricula. Offered on satisfactory-fail basis only.

Mathematics

Wilfred E. Barnes, Head of Department

Professors: Abian, Allen, Cornette, Dickson, Dyer, Fink, Gouwens, Homer, Keller, Kreider, Lambert, Lindahl, Mathews, Peglar, Prakash (Visiting Professor), Robinson, Sanderson, Seifert, Anne Steiner, Eugene Steiner, Vinograde, Wright.

Associate Professors: Arnold, Colwell, Dahiya, Gregorac, Heckenbach, Heimes, Isaacson, Meany, Miller, Sprague.

Assistant Professors: Arganbright, Brandner, Daniefs, Hentzel, Kegley, Laucke, McLaughlin, Nelson, Peake, Robertson, Rudolph, Stawn, Tondra.

Instructors: Abbey, Grimes, Harms, Huang, Kockler, Lammers, Martin, Neufeld, Ridolfo, Townswick.

Undergraduate Study

For the undergraduate curriculum in sciences and humanities, major in mathematics, leading to the degree Bachelor of Science, see Sciences and Humanities, Curriculum.

The program in mathematics offers training suitable for students planning to enter secondary school teaching, to work in mathematics and computation for industry or government, or to continue their studies
in graduate school. The requirements for an undergraduate major in mathematics are designed so that the student may have the opportunity for appropriate specialization to meet one or more of the foregoing objectives and, at the same time, obtain a thorough introduction to the mathematics underlying all of them.

The requirements for an undergraduate major in mathematics include 130, 131, 132, 201, 202, 213 and 233, plus at least 30 credits in mathematics at the 300 level or above, with 18 credits in the areas of algebra and advanced analysis, a minimum of 6 credits in each. A grade of C or better must be presented by majors in all prerequisite mathematics courses.

The department does not require foreign language study, but strongly recommends two years of French, German, or Russian for students contemplating graduate study in mathematics. It is also strongly recommended that each student majoring in mathematics include in his program substantial supporting work beyond the minimum general education requirement of the College in one or more areas of application of mathematics, such as other mathematical sciences, engineering, natural science, or social science.

Credits earned in the courses 104, 105, 109, 161, 162, 190, 191, 192, and 205 cannot be counted for credit toward graduation by mathematics majors.

Graduate Study

The department offers work for the degrees Master of Science and Doctor of Philosophy with majors in mathematics and in applied mathematics, and minor work to students taking major work in other departments.

Students desiring to do graduate work with a major in this department should present at least 18 quarter credits of work in mathematics beyond calculus. It is desirable that this should include advanced calculus and abstract algebra.

The M.S. degree in this department may be taken either with or without thesis. Candidates for the M.S. and Ph.D. degrees must pass a written comprehensive examination covering basic graduate work. There is no foreign language requirement for the M.S. degree. Ability to use two foreign languages (normally chosen from French, German, and Russian) as effective research tools in the student’s area of specialization is required for the Ph.D.

Master of Science candidates must have one year and Doctor of Philosophy candidates must have two years of supervised teaching experience. These minima are subject to increase in individual cases upon recommendation of the student’s committee and approval of the department head.

Open to graduate students for minor credit only:


Courses Primarily for Undergraduate Students

35. High School Geometry. Cr. 0. F. 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. Elements of Euclidean geometry including congruence, parallel lines, circles, similar polygons, perimeters and areas, surface areas, and volumes.

36. High School Algebra. Cr. 0. F. Students who do not have the third half-unit of algebra listed in the entrance requirements of some of the colleges may satisfy this requirement by completing this course. Fractions, graphs, laws of fundamental operations, important formulas from geometry, factors, linear equations, exponential and radical, ratio-proportion-variation, logarithms, progressions, binomial theorem, and inequalities.

37. Algebra and Trigonometry. Cr. 0. F.W.S.S.S. Prerequisite: One and one-half units of high school algebra. Sets, inequalities, polynomial equations and systems of equations, trigonometry, complex number field.

104. Finite Mathematics. (5-0) Cr. 5. F.W.S.S.S. 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. F.W.S. Techniques in number, algebra, and geometry, with the emphasis placed on their nontechnical content.

109. Precalculus Mathematics. (5-0) Cr. 5. F.W.S.S.S. Prerequisite: Two units of high school algebra, one unit of geometry, and one-half unit of trigonometry. Inequalities, functions and their graphs, including rational, circular, exponential, and logarithmic functions. For students who intend to take calculus.

Courses Primarily for Undergraduate Students

120, 121, 122, 223. Analytic Geometry and Calculus. 120, 121, 122: (5-0) Cr. 5 each. F.W.S.S.S. 223: (4-0) Cr. 4. F.W.S.S.S. Prerequisite: Two units of high school algebra, one unit of geometry, one-half unit of trigonometry. For students wanting a techniques-oriented course, including a review of precalculus mathematics. 120: Review of trigonometry, analytic geometry; derivatives of algebraic functions. 121: Applications of derivatives, integrals and applications, derivatives and integrals of transcendental functions. 122: Integration techniques, polar coordinates, three-dimensional analytic geometry, vectors. 223: Partial derivatives, multiple integrals, infinite series.

124. Calculus Laboratory. (1-0) Cr. 1 each time taken, maximum of 3 credits. F.W.S.S.S. Prerequisite: Classification in any calculus course. Problems arising from a numerical, algorithmic approach to calculus solved with the aid of a large-scale computer. Programming language, programming, and use of remote computer terminals in solving these problems.

130, 130A, 131, 132, 233. Analytic Geometry and Calculus. 130: (4-0) Cr. 4. F.W.S.S.S. 130A: (5-0) Cr. 4. F.W.S.S.S. 131, 132: (5-0) Cr. 5 each. F.W.S.S.S. Prerequisite: 130: Two units of high school algebra, one unit of geometry, one-half unit of trigonometry, introductory knowledge of analytic geometry. 130A: Two units of high school algebra, one unit of geometry, one-half unit of trigonometry. For students wanting a techniques-oriented course. 130: Analytic geometry, limits, continuity, differentiation of algebraic functions. 130A: Analytic geometry, functions, limits, continuity, differentiation of algebraic functions, review of analytic geometry and trigonometry. 131: Definite integrals, differentiation and integration of transcendental functions, two-dimensional vectors, vectors. 132: Vector-valued functions, lines and planes three-dimensional vectors, partial differentiation, multiple integrals. 233: Polynomial approximation, series, integration techniques, rotation of axes, quadratics, line integrals.

161, 162. Intuitive Calculus. (3-0) Cr. 3 each. 161: W.S.S.S.I; 162: S.S.S.S.I. Prerequisite: 104 or 109. Analytic geometry, differentiation and integration of elementary functions. Will not serve as prerequisite to 218.

190, 191, 192. Mathematical Concepts. (3-0) Cr. 3 each. F.W.S.S.S. Prerequisite: 191: 190. For prospective aleman-
201, 202. Intermediate Mathematical Analysis (3-0) Cr. 3 each. 201: F.W.; 202: W.S. Prerequisite: 122 or 132. The real number system, functions, and important theorems from calculus. Emphasis placed on developing mathematical maturity. Primarily for mathematics majors. Offered on satisfactory-fail basis only.

204. Discrete Probability. (3-0) Cr. 3. F.W. Prerequisite: Five credits in mathematics. Elementary discrete probability.

205. Linear Algebra. (3-0) Cr. 3. W.S. Prerequisite: Five credits in mathematics. Elementary linear algebra and matrices.

213. Elementary Differential Equations (3-0) Cr. 3. F.W.S.S. Prerequisite: 122 or 132. Elementary theory and applications of ordinary differential equations.

213L. Differential Equations Laboratory. (10) Cr. 1. F.W.S.S. Prerequisite: Classification in 213. Analytical methods of 213 supplemented by basic numerical methods (Euler, Runge-Kutta). Problems involve computer solutions. Offered on satisfactory-fail basis only.

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: 301: One year of calculus; 302: 301; 303: 302. Certain algebra structures and their transformations, including groups, rings, and vector spaces.

307. Theory of Matrices. (3-0) Cr. 3. F.S.S.S. Prerequisite: 223 or 233. Matrices and quadratic forms in the real and complex number fields.

308. Applications of Linear Algebra. (3-0) Cr. 3. S. Prerequisite: 205 or 303 or 307. Linear programming; applications of canonical matrices.


330. Topics in Euclidean Geometry. (3-0) Cr. 3. S.S.S. Prerequisite: One year of calculus. Concepts and properties of Euclidean geometric systems.


406. Introduction to Numerical Techniques for Computers. (Com S 406) (3-2) Cr. 3. F.W. Prerequisite: 223 or 233, Com S 201. Finding roots of equations and solving systems of linear equations iterative methods; programming these methods for computer solution.


409, 410, 411. Multivariable Calculus and Complex Variables. (3-0) Cr. 3 each. 409: F.W.S.S.; 410: W.S.S.S.; 411: F.S. Prerequisite: 409: 213; 410: 409; 411: 410 or 415. Certain frequently applied mathematical concepts presented with enough theory to promote understanding of applications. 409, 410: Calculus of functions of several variables, including vector calculus, line, surface, and multiple integrals. 411: Functions of a complex variable, including differentiation, integration and series expansions, residues and applications to evaluation of integrals, conformal mapping.

414, 415, 416. Advanced Calculus. (3-0) Cr. 3 each. Yr. Prerequisite: 213, 414: Normed linear spaces, completeness, limits, iteration of limits, differentiation of vector functions. 415: Integration on the line, multiple integrals, Green's theorem. 416: Topology include manifolds, summability theory, integration theory, approximation theory, function algebras, Fourier analysis, fixed-point theorems.

421. Mathematical Logic. (3-0) Cr. 3. F.S. Prerequisite: 301 or Phil 370. Validity, provability, consistency, completeness, definability, and decision problems for propositional calculus, predicate calculus, and generalized mathematical theories.

436, 437. Projective Geometry. (3-0) Cr. 3 each. 436: W.; 437: S. Prerequisite: 301. Projective properties studied by synthetic and analytic methods.

450. Number Theory. (3-0) Cr. 3. S. Prerequisite: 301. Properties of the integers. Diophantine equations, prime number distribution and representation problems.

498. History of Mathematics. (3-0) Cr. 3. F. Prerequisite: 223 or 233. Functions and their applications. Sources and growth of mathematical knowledge, contributions of outstanding mathematicians. Offered on satisfactory-fail basis only.

490. Special Problems. Cr. 1 to 3 each time taken. Prerequisite: 202.

497. Teaching of Secondary School Mathematics. (3-0) Cr. 3. W. Prerequisite: Twenty-two credits in college mathematics. Organization of subject matter, methods of presenting particular topics, evaluation of results.

Courses Primarily for Graduate Students, major or minor, open to qualified undergraduates.

504, 505, 506. Abstract Algebra. (3-0) Cr. 3 each. Yr. SS. Prerequisite: 302. Algebraic systems and their morphisms including groups, rings, fields, modules, and categories.


509. Computational Methods of Linear Algebra. (Com S 609) Cr. 3. S. Prerequisite: 303 or 307. Numerical methods involved in the solution of linear systems, matrix inversion, eigen-value problems (symmetric and nonsymmetric); completion method, ill-conditioned matrices; linear inequalities. Examples using University computers.

511, 512, 513. Functions of a Single Complex Variable. (3-4) Cr. 3 each. Yr. SS. Prerequisite: 410 or 415. Topological concepts for extended complex plane, analytic functions, conformal mappings, integration, power series, Laurent series. Cauchy residue theorem, evaluation of real integrals, harmonic functions, analytic continuation.

514, 515, 516. Real Analysis. (3-0) Cr. 3 each. Yr. SS. Prerequisite: 415. Basic concepts of topological spaces, function spaces, measure and integration.


524, 525. Theory of Automata. (Com S 524, 525) (3-0) Cr. 3 each. 524: W.; 525: S. Prerequisite: 421. Various notions and formalizations of computability and their comparison. Turing machines, Markov algorithms, recursive functions, unsolvability results, finite automata, sequential machines, synthesis and decomposition of abstract machines.
Courses for Graduate Students, major or minor

604. Advanced Topics in Abstract Algebra. (3-0) Cr. 3 each time taken. W.S. Prerequisite: 506. Associative or nonassociative algebras, groups, rings, fields, local algebras, categorical algebras.

607. Advanced Topics in Numerical Analysis. (Comp S 607) (3-0) Cr. 3. S. Prerequisite: 523; 508 and 509, or 408. Stability and error analysis, numerical solution of partial differential equations, successive overrelaxation methods, research work using University computer.

610. Seminar.

611. Advanced Topics in the Theory of Functions of a Single Complex Variable. (3-0) Cr. 3 each time taken. F.W.S. Prerequisite: 512, 536. The Riemann sphere, conformal mappings, topological indices, Cauchy integral formulas, power series, Laurent series, local mapping theorems, harmonic functions, the Poisson integral formula, the Dirichlet problem, the Mittag-Leffler theorem, special functions.

615. Advanced Topics in Foundations of Mathematics. (3-0) Cr. 3 each time taken. F.W.S. Prerequisite: Permission of instructor. Topics selected from mathematical logic, recursive function theory, model theory, and set theory.

621. Advanced Topics in Partial Differential Equations. (3-0) Cr. 3 each time taken. F.W.S. Prerequisite: 511, 521. Maximum principles, pointwise bounds, conservation equations, distributions, Hilbert space.

634. Advanced Topics in Topology. (3-0) Cr. 3 each time taken. F.W.S. Prerequisite: 536. Topics selected from dimension theory, topology of manifolds, homology and homotopy theory, structure of continua.

657. Advanced Topics in Ordinary Differential Equations. (3-0) Cr. 3 each time taken. F.W.S. Prerequisite: Permission of instructor. Selected topics from the theory of ordinary differential equations.

690. Special Topics. Cr. var. Prerequisite: Permission of instructor.

A. Algebra.
B. Functional Analysis.
C. Measure Theory.
D. Approximation Theory.
E. Linear Algebra.
F. Calculus of Variations.
T. Topology.
699. Research.

Mechanical Engineering

Arthur E. Bergles, Chairman of Department

Professors: Black, Fellinger, Henkin, Johnson, Larson, Mischke, Scrovy.

Associate Professors: Cook, Fisher, Gould, Hall, Junkhan, Kavanagh, Myers, Okishi, Peters, Pletcher.

Assistant Professors: Bahadar, Bathie, Hacker, Joensen, Johansen, Knight, Van Meter, Wandeling.

Undergraduate Study

For undergraduate curriculum in mechanical engineering leading to the degree Bachelor of Science, see College of Engineering, Curricula.

Mechanical engineering can be considered to be
concerned with the processing of energy in all its forms, and with its control and application to useful purposes. Since machines, systems and processes for utilization of energy are included in all areas of modern technology, mechanical engineering graduates practice in every major industry. About one-fourth of all engineers practicing today have been educated as mechanical engineers. Their activities include research and development, design, construction, testing, production, operation, sales, and technical management.

The undergraduate curriculum in mechanical engineering provides a broad foundation in the diverse and rapidly changing areas of modern technology. The curriculum is built upon a strong base of mathematics, and the fundamental sciences of physics and chemistry. The engineering science studies include solid mechanics, materials, thermodynamics, fluid mechanics, heat transfer, and electrical theory. Applied courses in analysis, experimental engineering, and design provide the basis for the synthesis of real problem solutions. A comprehensive sequence of electives in social and humanistic studies is a vital part of the required curriculum.

Senior students are offered opportunity to specialize in a wide variety of technical application areas. The Department offers electives in material considerations in design, and in the analysis and design of automatic control systems, power plants, internal combustion engines, gas turbines and other turbomachinery, environmental control systems, mechanisms, and other machinery. Students who plan to undertake graduate study may select from these as well as other electives as preparation for advanced study. In combination with the required curriculum, these electives provide a broad background so that the graduate engineer can enter traditional areas of mechanical engineering, or accept such new challenges as the energy crisis, environmental protection, or biomedical engineering.

A five year cooperative education (work-study) program is available to students in the Department.

Graduate Study

The Department offers work for the degrees Master of Science, Master of Engineering, and Doctor of Philosophy, and minor work to students majoring in other departments. A student may major in mechanical engineering at the masters level. Doctoral work is taken as a joint major with one of several departments offering courses in a related field. Course offerings in the Department may be used in co-major or minor programs for students in other departments.

At the time of admission, graduate students usually have completed an undergraduate curriculum similar to that required of undergraduate students in the Department.

The Department’s graduate program emphasizes advanced study and research on such topics as mechanical properties of polymers, computer-aided design, automatic control systems, instrumentation and design of experiments, heat and mass transfer, fluid flow modeling, gas dynamics, turbomachinery components, energy conversion and utilization, and technology and social change.

The requirements for advanced degrees, including foreign languages, are established by the student’s advisory committee. There is no foreign language requirement for the degree Master of Engineering or the degree Master of Science. Candidates for the degree Doctor of Philosophy are normally expected to demonstrate a high degree of competence in one language, or a satisfactory reading competence in two languages.


Courses Primarily for Undergraduate Students

100. Technical Lecture. (1-0) Cr. R. Field of mechanical engineering, its opportunities and requirements.

251, 252. Introduction to Mechanical Engineering I, II. (4-4) Cr. 4, F. W. Prerequisite: Math 215, 216, Elem Stat. 1-0. Coreq: Math 217, 218. Survey of the fundamental sciences of physics and chemistry. The engineering science studies include solid mechanics, materials, thermodynamics, fluid mechanics, heat transfer, and electrical theory. ELECTIVE.

300. Inspection Trip Cr. R; S. Prerequisite: Junior mechanical engineering classification. Inspection trip to industrial centers.

321. Thermodynamics I. (4-0) Cr. 4. F.W. Prerequisite: Math 213, Phys 222, junior classification. Properties and fundamental equations for states and processes for gases, vapors, and gas mixtures.

322. Thermodynamics II. (3-0) Cr. 3. W. S. Prerequisite: 321. Air tables, compressible flow, compressors and turbines, air standard cycles for engines and turbines.

333. Thermodynamics III. (3-0) Cr. 3. F. S. Prerequisite: 322. Vapor flow cycles, refrigeration, property relations and processes for real gases. Gas mixtures with constant and variable specific heats. Psychrometry and introduction to air conditioning processes.


325. Heat Transfer. (3-0) Cr. 3. S. S. Prerequisite: 321. Solution of practical engineering problems involving transfer of heat by conduction, radiation, and convection.

331. Mechanical Behavior of Materials. (Met 331) (3-0) Cr. 4. F.W.S.S. Prerequisite: Met 230, E M 235. Application of the basic principles of structure of solids to the study and control of mechanical properties. Qualitative and quantitative relationships between microstructure and mechanical properties.

332, 333. Manufacturing Processes I, II, (Met 332, 333) (3-2) Cr. 3 each. 332: W.B.S.S.; 333: F.S. Prerequisite: 332; 331; 333: 332. The relationship between material properties, manufacturing process, and product properties. The basic processes (casting, welding, forming and machining) and the functional characteristics of equipment. Manufacturing considerations in design.
335. Fundamentals of Mechanical Behavior of Materials. (2-2) Cr. 3. W. Prerequisite: Mat 231, E M 325. Study and control of mechanical and physical properties. Failure criteria and material selection for engineering applications.


406. Heating, Ventilation, and Air Conditioning. (4-0) Cr. 4. W. Prerequisite: Con E 372 or Arch 343. Elements of heat transfer, thermodynamics, and fluid flow as applied to heating, ventilating, and air conditioning. Design of duct and piping systems.


411. Industrial Automatic Control. (2-2) Cr. 3. F. S. Prerequisite: 422. Methods and principles of automatic control. Pneumatic, hydraulic, and electrical systems. Representative applications of automatic control systems. Mathematical analysis of control systems.


423. Mechanical Systems Design. (1-9) Cr. 4. F. S.S. Prerequisite: 333, 420, 421, 422. Solution of total design problems involving the use of basic engineering concepts and industrial practices.


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. Fundamentals of vapor compression refrigeration; multiple pressure cycles. Absorption refrigeration, air cycles, refrigerants, cryogenics, steam jet refrigeration, thermoelectric cooling, and reversed cycles.

429. Internal Combustion Engine Design. (2-6) Cr. 4. S. Prerequisite: 445. Credit or classification in 423. Design and layout of a high-speed internal combustion engine of carburetion or diesel type.

444. Elements and Performance of Power Plants. (4-4) Cr. 4. W. S. Prerequisite: 324, 425. Analysis of power supply systems and their components: turbines, steam generators, fans, pumps, heat exchangers, cooling water systems. Environmental pollution due to energy conversion.


448. Power Plant Design. (0-6) Cr. 3. S. Prerequisite 444. Design of a power plant to meet a specified energy demand. Selection and or synthesis of principle elements, including auxiliary equipment.


462. Engineering Measurements II (1-6) Cr. 3. W. S. Prerequisite: 324, 425, 461. ASME Power Test Codes and ASTM Standard Test Procedures applied to selected areas of measurement; use of analogies and similarity in engineering experimentation, advanced engineering measurements, presentation of formal reports.

470. Computer-Aided Design. (3-0) Cr. 3. S. S. Prerequisite: Senior classification and an elementary knowledge of FORTRAN. An examination of the morphology of design processes, the structure of the FORTRAN language, figures of merit, searching and optimization techniques leading to an algorithmic approach to design.

490. Special Problems. Cr. 3 to 5. Prerequisite: Senior classification. Investigation of topics holding special interest of student. Comprehensive report required. Election of course and topic must be approved by department head. H. Honors Program.

Courses Primarily for Graduate Students, major or minor, open to qualified undergraduates.


502. Design of Engineering Experiments II (3-0) Cr. 3. W. Prerequisite: 501, Stat 401. Planning of experimental programs and design of experiments to obtain data such that results are within prescribed limits of precision.

513. Lubrication and Friction. (4-0) Cr. 4. W. Prerequisite: 420, 424. Theories of lubrication and friction and their application to design.

515. Advanced Design. (4-0) Cr. 4. W. Prerequisite: E M 514. Experimental, empirical, and rational methods of analysis and synthesis in the solution of advanced design problems.
Courses for Graduate Students, major or minor

600. Advanced Machine Design. (3-0) Cr. 3. S. Prerequisite: Permission of instructor. Mathematical and experimental analysis of problems in field of dynamics of machinery, stress analysis, and vibration. Choice of work any quarter determined by aptitudes and interests of class.

610. Dynamics of Fluid Control Systems. (3-0) Cr. 3. W. Prerequisite: 411, 424. Dynamical characteristics of fluid control systems and elements.

620. Seminar. (1-0) Cr. 1. F.


626. Advanced Heat Transfer II. (3-0) Cr. 3. Alt. W., offered 1975. Prerequisite: 425 or equivalent. Transfer of energy by thermal radiation.


699. Research.

Metallurgy

Monroe S. Wechsler, Chairman of Department

Professors: Carlson, Chen, Chiotti, Gschneidner, Henkin, McCorkle, Peterson, Smith, Specking, Verhoeven, Wilhelm (Emeritus).

Associate Professors: Kayser, Larsen, Patterson, Scott, Trivedi.

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 metallurgical engineering, see College of Engineering, Curricula.

To best prepare the student to meet the challenges
of this broad field, the curriculum in metallurgical engineering is based on a core of courses in chemistry, physics, mathematics, and metallurgical engineering principles. A wide choice of electives makes it possible for students, in consultation with their adviser, to develop a program which best fits their particular interests and aptitudes. Elective programs should complement the core curriculum, avoiding undue specialization or aimless diversification.

For an undergraduate curriculum in sciences and humanities, with a major in metallurgy, see Sciences and Humanities, Curriculum. Students in this curriculum usually will select the following basic courses: 201, 203, 205, 230, 300, 301, 302, 303, 305, 306, 307, 360, 361, 401, 402, and six additional credits in courses numbered 400 or above.

As supporting work, undergraduate majors find the following courses desirable: Math 120, 121, 122, 223 (or 130, 131, 132, 213, 233) 213 plus one additional course in mathematics, statistics, or computer science; Phys 221, 222, 223; Chem 141, 141L, 142, 142L (or 147, 147L, 148, 148L) 321; E M 274, 325.

These lists of courses are not regarded as fixed requirements or as complete outlines of work necessary for the major. Students will plan their complete programs with the help of their advisers.

The metallurgist or metallurgical engineer finds opportunities in many industries such as the metal-producing, refining, and processing industries or those which utilize metals, such as the automotive, aerospace, utilities, electronic, oil refining, and farm implement industries. He may choose to work in the areas of production, sales, or research. Students interested in teaching or research in metallurgy or metallurgical engineering should seriously consider graduate study.

### Courses Primarily for Undergraduate Students

#### 100. Technical Lecture. (1-0) Cr. R; W. Introduction to the metallurgical profession. Career opportunities and requirements.

- 201. Extractive Metallurgy. (3-0) Cr. 3. W. Prerequisite: Chem 142, 142L. Occurrence and preparation of metals. Stoichiometry and material balances. Introduction to equilibrium and thermodynamics.
- 203. Metal Processing. (3-0) Cr. 3. S. Prerequisite: Chem 142, 142L. Methods and principles of consolidation and primary working of metals, including melting, casting, joining, and powder metallurgy.
- 205. Metallurgy Laboratory. (1-0) Cr. 3. S. Prerequisite: 201; 230 or 231; Phys 223. Introduction to experimental metallurgy. Principles and use of laboratory instruments, taking and analysis of data. Laboratory safety, report writing.


#### 231. Metallurgy for Engineers. (3-0) Cr. 3. F.W.S. Prerequisite: Chem 141, Math 122 or 132. Introduction to atomic bonding, structure of crystals and polycrystalline aggregates, deformation of solids, phase equilibria, and transformations. Applications to the engineering properties of metals. For students not majoring in metallurgy.

#### 300. Metallurgy Seminar. (1-0) Cr. I. F.W.S. Topics of current interest in metallurgy.

- 301, 302, 303. Physical Metallurgy. (4-0) Cr. 4 each. Yr. Prerequisite: 230 or 231. 301: Stoichiometry. X-ray diffraction, basic dialation 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. 305: To be taken concurrently with sequence 301, 302, 303. Experiments in X-ray diffraction, measurement of physical properties, pyrometry, heat treatment, metallography, mechanical testing.

#### 360. Metallurgical Thermodynamics. (3-0) Cr. 3. W. Prerequisite: Chem 321. Concepts of fugacity, activity, activity coefficients, and the equilibrium constant. Thermodynamic description of solutions and unary and binary
phase boundaries. Reaction kinetics, the electrochemistry of solid and liquid electrolytes and an introduction to corrosion theory.

361. Chemical Metallurgy. (3-0) Cr. 3. Prerequisite: Math 213, Phys. 222, Chem 142, 142L. Principles of fluid flow, heat and mass transfer. Applications to solidification, furnace design, pyrometry, reactions at metal surfaces and kinetics of metallurgical processes.

401, 402. Mechanical Behavior of Metals. (3-0) Cr. 3 each. 401: F.; 402: W. Prerequisite: 303. Elasticity and plasticity, applications to metallurgical problems and materials testing. Fracture, fatigue, and residual stresses. Advanced metal-processing technology.

410. Physical Metallurgy. (4-0) Cr. 4. F. Prerequisite: Permission of instructor. An introduction to physical metallurgy for advanced students in science or engineering who have little or no prior preparation in metallurgy. Open not to students majoring in metallurgy.

433. Metallurgical Engineering Design. (3-0) Cr. 3. S. Prerequisite: 402. The application of physical, chemical, and mechanical metallurgical principles to the design of metal parts and processes.

490. Special Problems. Cr. arr. Prerequisite: Junior classification, permission of instructor. Investigation of individual research problems or special topics. H. Honors.

Courses Primarily for Graduate Students, major or minor, open to qualified undergraduates


512. Introductory Metal Theory. (3-0) Cr. 3. W. Prerequisite: Credit or classification in Math 409. Free electron theory and band theory. Brillouin zones and Fermi surfaces, electronic conductivity and scattering processes, magnetic behavior, electronic and lattice heat capacities, cohesion and elastic constants.

532. Structure and Properties of Steel. (3-0) Cr. 3. S. Prerequisite: 303, or 331, or 410. Application of fundamental concepts of phase transformations, mechanical behavior, and heat flow to the problems of heat treatment and selection of steels.

540. Theory of Dislocations. (3-0) Cr. 3. F. Prerequisite: Credit or classification in Math 409. Theory of dislocations based on linear elasticity. Self and interaction energies of dislocations. The concept of forces on dislocations and their calculations: line tension, image, chemical, and Feler's forces.

541. Applications of Dislocation Theory. (3-0) Cr. 3. W. Prerequisite: 540. Dislocations treated from the geometric viewpoint. Partial dislocations, stacking faults, and pile-ups; dislocation generation, multiplication, point-defect production, dislocation networks and boundaries. Concepts applied to strengthening mechanisms and deformation.

555. X-Ray Diffraction. (3-0) Cr. 3. W. Prerequisite: 301 or 410. Kinematical diffraction theory, dispersion-corrected scattering factors, the Debye-Waller factor, retraction and extinction. Applications of Debye-Scherrer and diffractometer methods, and neutron and electron diffraction.

557. X-Ray Diffraction Laboratory. (0-6) Cr. 2. S. Prerequisite: 555. Determination of the orientation of single crystals, crystal structure, lattice parameters, particle sizes, long-range order parameters, residual stresses, phase boundaries in alloys and retained austenite. Statistical methods of error analysis and computer programmed solutions.

561. Principles of Chemical and Extractive Metallurgy. (3-0) Cr. 3. F. Prerequisite: Chem 321. Occurrence and production of metals, including the less common metals. Analysis of the economic, stoichiometric, and thermodynamic principles in chemical metallurgy.

562. Principles of Metallurgical Thermodynamics. (3-0) Cr. 3. F. Prerequisite: Chem 321, Math 213. Classical thermodynamics, consequences of the three laws, application and the mathematical basis for the description of homogeneous and heterogeneous equilibria and phase relations in unary and multicomponent systems.

563. Applications of Metallurgical Thermodynamics. (3-0) Cr. 3. W. Prerequisite: 562. Solubility of gases in metals, oxidation of metals and alloys, thermochrometrical and steelmaking, atmosphere control with gas mixture, special applications of Clausius-Clapeyron equation, use of Richardson and Jeffes charts, thermodynamics of alloys and interaction coefficients.

571. Corrosion and Oxidation. (3-0) Cr. 3. F. Prerequisite: 360 or Chem 323. A study of the origin, development, and current applicability of theories of corrosion and oxidation of metals.

590. Special Topics in Metallurgy. Cr. arr. Prerequisite: Permission of instructor. Topics of current interest in metallurgy.

Courses for Graduate Students, major or minor

610, 611. Alloy Theory. (3-0) Cr. 3 each. Alt. F.; 610 offered 1974; 611 offered 1973. 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.


655. X-Ray Scattering from Crystalline Materials. (2-0) Cr. 2 each time taken. Alt. F., offered 1973. Prerequisite: 555. Selected topics including temperature diffuse scattering, the Debye-Waller factor, short and long-range order, stacking faults, and magnetic and antiphase domain boundaries. Electron diffraction and Moiré patterns. Field-ion microscopy.

662. Advanced Topics in Metallurgical Thermodynamics. Cr. 2 or 3 each time taken. Offered on request. Prerequisite: 562. Thermodynamics of irreversible processes. Research on the application of thermodynamics to physical metallurgy. Statistical thermodynamics and its application to metallurgical processes.

691. Metallurgy Seminar. Cr. arr.

699. Research
Meteorology

For description of courses, see Earth Science.

Military Science

Col. Harold S. Whitlock, Head of Department
Assistant Professors: Bailey, Kellerhals, Konermann, Leffler, Wheless.

The Army military education program is designed to qualify undergraduate and graduate students for commissioning as second lieutenants and for a professional or reserve officer career. Freshman and upperclassmen with four years of academic work remaining, two years of which must be undergraduate work, are encouraged to enroll in the four-year program. Continuation in the last two years of the four-year program is by application and is competitive. Men with sophomore or higher academic status and with two or more years of academic work remaining may apply for the two-year program during the winter prior to the academic year they wish to start the program. Successful applicants will attend a six-week summer session at a military installation which qualifies them to enter the third year of the four-year program. Upon completion of the third year of Military Science, all students attend an advanced six-week summer session at an active military installation. Students who complete the two- or four-year program and who have been awarded a baccalaureate or higher degree are commissioned as second lieutenants. Army scholarship students and students designated as Distinguished Military Graduates may apply for and, if selected, receive a Regular Army commission; all others receive commissions in the Army Reserve.

Army scholarships for from one to four years are available as described in the "Officer Education Programs" portion of this catalog. Qualified students desiring to become Army aviators may enter the Flight Program during their fourth year of Military Science and earn the FAA private pilot's certificate. Third- and fourth-year students in the four-year program and all two-year program students receive a monthly subsistence allowance. All students are furnished uniforms and military science textbooks and all expenses involved for the six-week summer sessions at military installations.

Active duty obligations are as follows: four years for Army scholarship students, three years for Regular Army commissions, three years for Flight Program students and from three months to two years for all others.

Undergraduate Study

Army officer education students may pursue any curriculum leading to a baccalaureate or higher degree. Four-year program cadets must complete 7 credits of 100- and 200-level Military Science courses during the first two years. All two- and four-year program cadets must complete 18 credits of 300- and 400-level Military Science courses plus one of the following courses prior to being commissioned.

Introduction to International Politics, Pol S 251, 3 cr.
International Law, Pol S 422, 3 cr.
United States Foreign Policy, Pol S 458, 3 cr. (preferred).

Four-year program students must also complete History 387A prior to their third year of officer education and 387B prior to being commissioned in lieu of enrolling in Military Science during the winter quarter of their second year. All students must take the leadership training course listed in conjunction with the Military Science Course they are taking (e.g., MS101A with MS101). Military Science courses are designed primarily for students seeking a commission in the United States Army; however, any student may enroll in a particular course, subject to the approval of the professor of military science and the availability of classroom space.

Also see Officer Education, this catalog.

Courses Primarily for Undergraduate Students

102. Military Science I—Evolution of Weapons and Warfare. (1.0) Cr. 1. W. Evolution of means to wage war as affected by technological developments and changing concepts, with emphasis on modern weapons systems, including use and maintenance of individual weapons.
103. Military Science I—The United States Defense Establishment. (1.0) Cr. 1. S. Role and organization of the national defense establishment as an instrument of policy in providing for the national security. Interrelationships of the Department of Defense, State Department, Joint Chiefs of Staff, and the services under the Department of Defense.
101A, 102A, 103A. Leadership Laboratory I. (0-1) Cr. R. Yr. Initial military training to provide experience in leadership and to touch the customs and courtesies of the services.
201. Military Science II—Land Navigation. (2.0) Cr. 2. F. Prerequisite: 103 or approval of professor of military science. Characteristics and features of the earth's land mass and application of methods of conducting navigation on land by use of topographical maps and aerial photographs.
203. Military Science II—Military Tactics. (2.0) Cr. 2. S. Prerequisite: 201 or approval of professor of military science. Actions and attitudes applied in both nuclear and nonnuclear warfare; consideration of the principles of organization, composition, and missions of operational elements in limited, conventional, and general war.
201A, 202A, 203A. Leadership Laboratory II. (0-1) Cr. R. Yr. Continuation of skills learned in Leadership
Undergraduate Study

The Iowa State University Department of Music maintains a philosophy of education which draws its goals from the larger purposes of liberal arts education. As a humanistic discipline, music is an integral part of the college program which attempts to offer the student a broad background in all areas of human experience. The program of the music department is twofold:

1. To provide opportunities for any student to develop an understanding and appreciation of music as part of a liberal education. Courses in music literature, theory, and areas of performance are available to the general student.

2. To provide a four-year course of professional study to students who wish to prepare for careers in teaching, performance, composition, and graduate studies in music or related areas.

Bachelor of Arts—Music Major

For the undergraduate curriculum in sciences and humanities, major in music, leading to the degree Bachelor of Arts, see Sciences and Humanities, Curriculum.

Candidates for the degree Bachelor of Arts with a music major will normally complete the following courses: 104, 119, 201, 202, 203, 219, 304, 305, 306, 319, 335, 356, 357, 361, 419; and 4 to 6 credits from 371, 373, 375, 376, 377, 380, 382, and 490D. All students are expected to participate in performing ensembles each quarter. The following may be taken on an elective basis: 362, 367, 368, 369, 490A, B, C, D, E, F, H, Y, Z.

Bachelor of Arts students whose chief professional interest lies in research are encouraged to minor in foreign languages, history, literature, or philosophy.

Bachelor of Music

For the undergraduate curriculum in music, leading to the degree Bachelor of Music, see Sciences and Humanities, Curriculum.

Candidates for the Bachelor of Music will complete the following requirements:

1. General Education...............................71-75 credits
2. Library................................................1 credit
3. Music Core..........................................71-73 credits
4. Music Major (Students must select one of the following areas of concentration: history and literature, music education, organ, piano, string instruments, theory-composition, voice, and wind or percussion instrument)......................49-57 credits

General Requirements

Music majors are required to pass the department piano proficiency examination, a terminal ear-training proficiency examination. All music majors enrolled for applied music courses will attend a one-hour seminar each week in their
areas; applied grades will reflect attendance and participation in these seminars. All music majors will enroll in Music 490X (Recital Attendance) each quarter in which they are enrolled in applied music courses.

Proficiency in music repertoire and technique will be determined by departmental examination as follows:

Acceptance Examination. To be accepted as a music major, the student must demonstrate an appropriate level of performance as well as potential in at least one performing medium. In addition, a student must satisfactorily complete a standardized music achievement examination which will be administered to all applicants. The acceptance examination will be given by members of the departmental faculty during summer orientation, the week preceding the opening of classes for fall quarter, during the annual Talent Evaluation Day, or by appointment. Students should request this examination in the Department of Music office before deciding on the music major.

Continuation Examination. To be approved for continuation as music majors on the junior level and beyond, students must pass a continuation examination in repertoire and technique (normally at the end of the sixth quarter). This examination will establish acceptable solo ability in at least one instrument or voice, including understanding of performance technique. At the time of this examination the student should have completed the department piano proficiency examination and the terminal ear-training examination. The student's academic standing will be reviewed at this time and the above factors will be weighed in advising the student on occupational goals.

Graduation Proficiency. To be recommended for graduation, a music student should demonstrate to the music faculty mature acquaintance with performance styles, technique, and repertoire. All music majors will participate in departmental recitals to the satisfaction of the department and will present a graduation recital.

Graduate Study

Courses open for graduate minor credit are: 380, 382, 467, 468, 469, 490A through E.

Courses Primarily for Undergraduate Students

14. Applied Music; Preparatory. (1/2-4) Cr. 0. F.W.S.SSL. Prerequisite: Audition and permission of instructor and department head. Applied music for nonmajor students. Available on a limited basis, depending upon teaching loads of faculty. See 119 for letter designations for various instruments.

9. Iowa State University Festival Chorus. Cr. 0. F. Open to students and staff. Performance at annual Christmas Festival.

100. Fundamentals of Music. (1-2) Cr. 2. F.W.S.SSL. Prerequisite: Elementary performing ability on an instrument or in voice. Notation, recognition and execution of scales, intervals, triads, and rhythm; key signatures; time signatures; transposition.

102. Introduction to Music Literature. (3-0) Cr. 3. F.W.S.SSL. Designed to expand the music listening experiences of the general student through greater awareness of differences in techniques of listening, performance media, and materials of the art. Introduction to the components of music and form via listening. Student need not be able to perform or read music.

104. Introduction to Music Listening. (2-3) Cr. 3. S. Prerequisite: Departmental major status or permission of instructor. Expansion of music listening activities of the music major through emphasis on materials of music, texture, form, style, and literature of major performance media. Introduction to score reading, terminology, and analysis.

*111. Symphony Band. (0-3) Cr. 1 each time taken. F.W.S.SSL. Prerequisite: Open to all students who qualify by audition. Emphasis on significant extended compositions for wind and percussion instruments. Performances include three formal concerts on campus, and the annual tour.

*112. Concert Band. (0-2) Cr. 1 each time taken. F.W.S.SSL. Prerequisite: Open to all students who have performed on a wind or percussion instrument in high school band or orchestra. Repertoire includes the broad spectrum of band music. A concert is presented each quarter.

*113. Jazz Ensemble. (0-1) Cr. 1 each time taken. F.W.S.SSL. Prerequisite: Audition and permission of instructor. Designed to explore various styles and trends in contemporary jazz.

*114. Marching Band. (0-3) Cr. 1 each time taken. F. Prerequisite: Permission of instructor; open to instrumentalists who have performed on a wind or percussion instrument in high school band or orchestra. Presentation of pregame and halftime shows at each home and one away football game. Previous marching band experience not required.

118, 218, 318, 418. Applied Music; Non-Major. (1-2/0 or 1-0) Cr. 1 or 2 each time taken. F.W.S.SSL. Prerequisite: Audition and permission of instructor. Applied Music for the general student. Will not satisfy applied music requirements for music majors. See Music 119 for letter designation for various instruments.

119, 219, 319, 419. Applied Music; Major. (1-2/1 or 1-0) Cr. 1 to 3 each time taken. F.W.S.SSL. Prerequisite: Permission of instructor; restricted to music majors. Minimum weekly practice of 5 hours per credit is expected. Weekly seminar required.

A. Voice.
B. Flute.
C. Organ.
D. Strings.
E. Carillon.
F. Woodwinds.
G. Brass.
H. Percussion.

127, 128, 129. Class Study in Piano L (0-2) Cr. 1 each. Yr. Prerequisite: Departmental major status; must be taken in sequence. Scales (all major and harmonic minor), arpeggios, dominant 7ths and diminished 7ths (3 keys), cadences, harmonized scales, harmonization, sight reading, transposition.

*131. Cardinal Keynote Singers. (0-2) Cr. 1 each time taken. F.W.S.SSL. Prerequisite: Open by audition to all students who are enrolled in another choral ensemble. Small mixed chorus featuring various forms of popular music. Performances on and off campus.

133, Basic Voice Techniques. (0-2) Cr. 1. F.W.S.SSL. Prerequisite: Permission of instructor. Class study in vocal techniques of vocal production: respiration, phonation, resonance, articulation, and performance.

*141. University Chorus. (0-3) Cr. 1 each time taken. F.W.S.SSL. Prerequisite: Open to all students by audition. Campus concerts. Rehearsals three times a week in addition to Festival Chorus.
148. Summer Band. (0-2) Cr. 1 each time taken. SSL. Prerequisite: Open to all students who have performed on a wind or percussion instrument in band or orchestra. One concert presented in SSL.

151. Oratorio Chorus. (0-3) Cr. 1 each time taken. F.W.S. Prerequisite: Open to all students by audition. Concerts with ISU Symphony Orchestra and performances in conjunction with International Orchestra Festival. Rehearsals three times weekly in addition to Festival Chorus.

151. Iowa State Singers. (0-5) Cr. 1 each time taken. F.W.S. Prerequisite: Open to all students by audition. Campus Concerts, annual spring tour, and performances in conjunction with International Orchestra Festival. Rehearsals five times weekly in addition to Festival Chorus.

151. Chamber Singers. (0-3) Cr. 1 each time taken. F.W.S. Prerequisite: Open to all students by audition. Several appearances annually by a select group capable of advanced study and performing madrigals through modern music suitable to small ensemble.

151. Summer Chorus. (0-2) Cr. 1 each time taken. SSL. Open to students, staff, and community.

151. Symphony Orchestra. (0-2) Cr. 1 each time taken. F.W.S. Prerequisite: Open to all students by audition. Concerts presented each quarter; annual tour fall quarter.

201, 202, 203. Basic Materials of Music. (3-2) Cr. 4 each. Yr. Prerequisite: 201: 100 or departmental major status; 202: 201; 203: 202, 201: Brief review of fundamentals. Harmonic and melodic materials of the common practice period. Application of these materials in sight reading, ear training, keyboard, analysis, and writing. 202: Continuation of 201. Techniques of harmonization, nonharmonic tones, modulation. 203: Continuation of 201, 202. Chromatic harmony, smaller elements of formal structure, analysis, and creative work.

218. Applied Music: Non-Majors. (See Music 118.)

219. Applied Music: Majors. (See Music 119.)

227, 228, 229. Class Study in Piano II. (0-2) Cr. 1 each. Yr. Prerequisite: 129. Must be taken in sequence. Scales (all major, minor, and chromatic), arpeggios, dominant 7ths and diminished 7ths (all keys), cadences, harmonized scales, accompaniment patterns, harmonization, sight reading, and transposition.

301. Opera Studio. (1-3) Cr. 1 to 3 each time taken. F.W.S. Prerequisite: Permission of instructor. Pratt; Interpretation and coaching of selected opera scenes and chamber operas, including informal and public presentations.

304, 305, 306. Advanced Materials of Music. (3-2) Cr. 4 each. Yr. Prerequisite: 203. Should be taken in sequence. White Analysis of music from a variety of periods with emphasis on music of the late nineteenth and twentieth centuries, homophonic and contrapuntal forms, introduction to orchestration. Application of techniques and concepts in creative work.

310. Vocal Pedagogy. (30) Cr. 3. S. Prerequisite: 319A or vocal proficiency examination. Study of the physical, acoustical, and musical properties of the vocal instrument, including a survey of important texts and articles on singing and voice production.

318. Applied Music: Non-Majors. (See Music 118.)

319. Applied Music: Majors. (See Music 119.)

321. Advanced Ensemble. (30) Cr. 1. F.W.S. Prerequisite: Advanced proficiency and performing ability. Permission of director and department head. Performance in ensembles which demand high proficiency. Open to a limited number of undergraduate and graduate students.

A. Voice
B. Piano
C. Organ
D. Strings
E. Musica Antiqua
F. Woodwinds
G. Brass
H. Percussion
J. Mixed


361. Conducting I. (20) Cr. 2. F. Prerequisite: 203. Swift. Introduction to conducting; beat patterns, use of baton, score reading.


364. Music in Early Childhood Education. (3-1) Cr. 3. W. S. Prerequisite: C 225 or Educ 344. Stark. Objectives, teaching approaches, and instructional materials appropriate for guiding musical experiences in preschool and kindergarten. Contributions of music to child development. Observation and participation with children.

365. Music in Elementary Education. (3-1) Cr. 3. F. W. Prerequisite: 100 or Educ 344. Stark. Objectives, teaching approaches, and instructional materials appropriate for elementary school children. Observation and participation with children.

366. Music in General Education. (3-1) Cr. 3. F. Prerequisite: 306. Stark. Objectives, curriculum, methods, and instructional materials appropriate for teaching general music in elementary and secondary schools. Observation and participation with children.

367. Practicum in String Instruments. (2-0) Cr. 2. F. Techniques and skills required for teaching of instruments. Examination of materials for school use. For the instrumental music specialist.

368. Practicum in Woodwind Instruments. (2-0) Cr. 2. W. Techniques and skills required for teaching of instruments. Examination of materials for school use. For the instrumental music specialist.

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.


380. Seminar in Music History. (30) Cr. 3. Alt. S., offered 1974. Prerequisite: 355, 356, 357. Bleyle. Detailed study of music written in the last century. Topics vary, including such diverse areas as the string quartets of Beethoven and Bartok, Wagner's Ring, and the music of Monteverdi. Topics will be selected by instructor and students.

418. Applied Music: Non-Majors. (See Music 118.)
419. Applied Music: Majors. (See Music 119.)


466. Music Education Through Performance. (3-2) Cr. 3. W. Prerequisite: 310; 362A or 362B; 366. Objectives, curriculum, methods, and instructional materials appropriate for teaching vocal or instrumental music in elementary and secondary schools. Separate laboratories provide practical experience in vocal music for the instrumentalists and in instrumental music for the vocalists. Observation of and participation with performing groups of public school age students.

A. Vocal. Stark.
B. Instrumental. Swift.

467. Advanced Practicum in String Instruments. (2-0) Cr. 2. W. Prerequisite: 319D or 367. Advanced techniques and skills required for teaching of instruments. Examination of materials for school use. For the instrumental specialist.

468. Advanced Practicum in Woodwind Instruments. (20) Cr. 2. S. Prerequisite: 319F or 368. Messenger. Advanced techniques and skills required for teaching of instruments. Examination of materials for school use. For the instrumental specialist.

469. Advanced Practicum in Brass and Percussion. (20) Cr. 2. F. Prerequisite: 319G or 319H or 369. Swift. Advanced techniques and skills required for teaching of instruments. Examination of materials for school use. For the instrumental specialist.

470. Graduation Recital. Cr. 2. F.W.S.SL. Prerequisite: 418. A public recital of literature which represents the student's accomplishment in his major applied area or in composition.

490. Special Problems. Cr. var. F.W.S.SL. Prerequisite: Permission of instructor; A through F–12 credits in music, approval of department head.

A. Education.
B. Theory.
C. Composition.
D. History.
E. Literature.
F. Applied Music.
G. Vocal.
H. Instrumental.
X. Recital Attendance.
Y. Music Literature—Instrumental.
Z. Music Literature—Vocal.

*Offered on satisfactory-fail basis only.

Naval Science

Col. W. A. Kluckman, Head of Department
Associate Professor: Cress.
Instructors: Egnovitch, Glor, Schrank, Swap, Watson.

The function of the Navy officer education program is to provide, by a permanent system of education in essential naval science and other academic subjects at civil educational institutions, a source from which qualified officers may be available for the Navy and the Marine Corps and their reserve components.

Students who enter the Navy officer education program may apply for either of two programs, the NROTC College Scholarship Program (financial assistance provided) or the College Program (nonscholarship/limited financial assistance). They pursue their studies like other students except that they meet certain requirements which will prepare them to serve as officers after graduation. Information is available from the professor of naval science, Iowa State University, concerning application, financial assistance, career opportunities, and active duty obligation. Also see Officer Education Programs in this catalog.

While in the program, students will participate in summer at-sea training cruises with pay and may take part in extracurricular activities which may help them decide which field of the Navy or Marine Corps they wish to enter. These activities include three cruises for scholarship and one for nonscholarship students, several student societies, and indoctrination trips to a naval air station and Marine Corps base. In addition, a Navy-subsidized flight instruction program enables selected students to earn a private pilot's license during their junior or senior year in school.

Undergraduate Study

Naval science courses are primarily for those students in the NROTC program. Other students may enroll in naval science courses with approval of the department head.

Students enrolled in the NROTC program must fulfill the following requirements:

1. NS 111, 112, 113, 211, 212, 213, 311, 312, 313, 411, 412, and 413. Marine option students will substitute NS 311M, 312M, 313M, 411M, 412M, and 413M for the 300 and 400 series listed above.

2. History 387A and 387B, and either Political Science 251, 422, or 458.

3. By the end of the sophomore year, all scholarship students must have completed mathematics through differential and integral calculus, and one year of physics, and one quarter of computer science.

NROTC students are not required to major in naval science. Scholarship NROTC students may pursue any major leading to a bachelor's or higher degree complementary to the naval profession and approved by the head of the department. Non-scholarship students may pursue any major leading to a bachelor's degree.

In addition to completing all naval science courses, students majoring in naval science must take the following courses: Math 120, 121, 122; statistics, 5
credits; Com S 201, 202, 361; Phys 111, 112, 113; Chem 141, 142: Hist 387A. 387B; Psych 101, geography, 3 credits; Pol S 458; and one year of a foreign language.

Naval science majors may substitute courses in computer science, physics, and chemistry with the approval of the head of the department.

Marine Corps option students majoring in naval science will elect 300- and 400-series marine option courses in lieu of 300- and 400-series naval science courses.

For basic undergraduate curriculum requirements, see Sciences and Humanities, Curriculum.

Courses Primarily for Undergraduate Students

Courses in Naval Science

111. Principles of Naval Organization. (3-2) Cr. 3. F. Organization, responsibilities, and capabilities of a modern navy with emphasis on the junior officer's role in the naval service.

112. Introduction to Naval Ship Systems. (3-2) Cr. 3. W. Prerequisite: 111. Auxiliary power systems, ship supporting sub-systems, auxiliary machinery, nuclear and gas turbine propulsion systems development.

113. Naval Ship Systems. (3-2) Cr. 3. S. Prerequisite: 112. Naval ship construction, compartmentation, stability, damage control, thermodynamics, steam and diesel propulsion systems.

211, 212, 213. Seapower and Maritime Affairs Seminar. (1/2-2) 211, 212: Cr. 1 each; 213: Cr. 2. Yr. Laboratory required for NROTC students only.

311, 312, 313. Navigation and Naval Operations. (3-2) Cr. 3 each. Yr. 311: Navigation procedures including piloting, dead reckoning, and radar; theory of celestial navigation. 312: Celestial navigation and solution of celestial navigation problems, theory of relative motion, maneuvering instructions and problems. 313: Electronic navigation, operations analysis, rules of the road.

411. Naval Weapons Systems. (3-2) Cr. 3. F. Weapons systems and the systems approach, including basic principles of weapon systems and fire control.

412. Naval Weapons Systems. (3-2) Cr. 3. W. Dynamics of the basic components of weapons control systems. Further development of the basic principles that underlie modern naval weapons systems.

413. Principles of Naval Management. (3-2) Cr. 3. S. Prerequisite: 111. Fundamentals of military management as applied to the naval service. Introduction to structure and principles of naval organization and to their concepts within the context of American social and industrial organization and practice. Emphasis on management and leadership functions required of junior officers.

Courses in Marine Option


312M. Evolution of Land Conflict and U.S. Military Principles. (3-2) Cr. 3. Alt. W., offered 1974. Prerequisite: 311M. Historical development of United States military strategy and tactics from the Civil War to the present.

313M. Naval Science Laboratory. (0-2) Cr. R; Alt. S., offered 1974. Open only to NROTC Marine-option students.

411M. Evolution of United States Amphibious Doctrine. (3-2) Cr. 3. Alt. F., offered 1974. United States amphibious doctrine 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 1975. The various arms composing amphibious forces, and the planning and execution of an amphibious operation.

413M. Naval Science Laboratory. (0-2) Cr; Alt. S. offered 1975. Open only to NROTC Marine-option students.

Nuclear Engineering

Administered by Department of Chemical Engineering and Nuclear Engineering

George Burnet, Jr., Head of Department

Professors: Danofsky, Roberts.

Associate Professors: Barcus, Greer, Hendrickson, Ma, Rohach, Valfells.

Assistant Professors: Ringham, Sabri.

Undergraduate Study

Nuclear engineering is a graduate program, hence the Bachelor of Science degree is not offered in this field. However, an integrated 5-year program leading to a bachelor's degree with a major in engineering science and a master's degree with major in nuclear engineering is available to students who have been admitted to the graduate college. Students may prepare for graduate work in nuclear engineering by pursuing undergraduate programs in the physical sciences, engineering, or engineering science.

A survey course, Nuc E 474, is available at the undergraduate level.

The department offers work for the degrees Master of Science, Master of Engineering, and Doctor of Philosophy with major in nuclear engineering. Minor work in nuclear engineering and in engineering simililude is offered to students taking major work in other departments.

Prerequisite to major work is the completion of a curriculum substantially equivalent to that required of undergraduate students in engineering at this institution. It is recommended that students contemplating graduate studies in nuclear engineering include courses in modern physics, heat transfer, chemistry beyond freshman chemistry, and mathematics beyond differential equations as part of their undergraduate preparation.

A foreign language is not required for the degrees Master of Science or Master of Engineering. For the degree Doctor of Philosophy a reading knowl-
edge of one foreign language is required. This requirement may be met by (1) attaining a minimum grade of B in 15 credits of foreign language at the collegiate level, or (2) demonstrating in a departmental examination a reading knowledge of a foreign language in the student's field of specialization.

**Course Primarily for Undergraduate Students**

474. Introduction to Nuclear Engineering. (3-0) Cr. 3. F.W.S. Prerequisite: M E 344, Math 321. Basics and problems of nuclear power development; considerations in nuclear reactor design; radiation hazards and shielding; use of radioisotopes in industry.

Courses Primarily for Graduate Students, major or minor, open to qualified undergraduates

501. Elements of Nuclear Engineering. (3-0) Cr. 3. F. Prerequisite: M E 321. Technical problems of nuclear power utilization and control. Isotope utilization.

502. Nuclear Reactor Materials. (3-0) Cr. 3. W. Prerequisite: 501 and permission of instructor. Mechanical and nuclear properties of solid, fluid, and gaseous reactor materials. Radiation effects.

503. Nuclear Reactor Materials. (3-0) Cr. 3. S. Prerequisite: 502. Mechanical and nuclear properties of solid and fluid reactor materials. Thermal and structural problems in reactors.

504. Nuclear Reactor Design. (1-6) Cr. 3. S.; or (3-15) Cr. 8. 12 wk. SS. Prerequisite: Credit or classification in 537. Engineering aspects of reactor design and use of nuclear power.


507. Radiation Safety. (3-0) Cr. 3. W. Prerequisite: Permission of instructor. Sources and nature of radiation, measurement techniques, somatic and genetic effects, AEC regulations, and safety procedures.


511. Nuclear Fuels and Waste. (3-0) Cr. 3. S. Prerequisite: Permission of instructor. Preparation of reactor fuels and handling of radioactive waste.

512. Reprocessing Nuclear Fuels. (3-0) Cr. 3. SS. Prerequisite: 511. Principles of nuclear reprocessing methods.


524. Nuclear Power Economics. (3-0) Cr. 3. S. Prerequisite: 501. Economics of direct-cycle and indirect-cycle nuclear reactor systems, fuel cells, direct conversion. Comparisons with wind, tidal, solar, geothermal, hydrothermal, and fossil fuels. Direct secondary effects.

534. Reactor Stress Analysis. (3-0) Cr. 3. Prerequisite: E M 324, Math 321. Analysis of stresses in reactor elements and structures. Thermal stresses in fuel elements and reactor vessels. Design of containment structures.

535. Nuclear Physics for Engineers. (4-0) Cr. 4. F. Prerequisite: Math 321, Phys 223. Atomic and nuclear structure, introduction to quantum theory, fundamental particles; isotopes; alpha, beta, and gamma radiation.

536, 537. Elementary Reactor Theory. (3-0) Cr. 3 each. W.S. Prerequisite: 536 or Phys 483 or 593; Math 322. Diffusion of neutrons, homogeneous and heterogeneous reactors, reactor control, perturbation theory, and transport theory.


541, 542, 543. Reactor Laboratory. (1-6) Cr. 3 each. F.W.S. Prerequisite: 510. Laboratory problems involving the nuclear reactor.

554. Radioisotopes in Engineering. (2-4) Cr. 4. F. Prerequisite: Permission of instructor. Principles of industrial utilization of radioisotopes and applications in engineering.

561, 562. Nuclear Reactor Dynamics. (3-4) Cr. 4 each. W.S. Prerequisite: 537, 540. Principles of reactor control and safety. 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 probabilities of nuclear accidents. Reactor siting, safeguards, containment.


581, 582, 583. Reactor Analysis. (3-0); (2-2); (2-2) Cr. 3 each. Yr. Prerequisite: 537, Math 408. Application of numerical-analysis techniques to thermal and fast reactors.

590. Special Topics. (2 to 5) Cr. 2 to 5.

591, 592. Ocean Engineering Simulation. (3-0) Cr. 3 each. W.S. Prerequisite: E Sci 481 or 484. Development of mathematical and laboratory models and analogs for the solution of nuclear engineering problems associated with the ocean environment. Coastal and harbor applications. Deep-sea applications.

Courses for Graduate Students, major or minor

602. Radiation Shielding. (3-0) Cr. 3. Prerequisite: 504, 510, 536. Design of shielding systems for protection against gamma rays and neutrons. Applications to nuclear reactors, cooling systems, processing equipment, and other engineering units.


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. Exploitation of new concepts in nuclear engineering. Reactor systems, thermonuclear developments, fission, fusion, and mass-energy transducers.

651, 652, 653. Interaction of Materials and Radiation. (3-2) Cr. 4 each. Alt. Yr. as arr. Prerequisite: 502, 536. Interaction between alpha, beta, gamma and neutron radiation and materials; absorption and scattering processes, influence on properties, shielding.

654. Selected Topics in Radiosotope Production and Applications. (3-0) Cr. 3 each. Alt. Yr. as arr. Prerequisite: 504. A series of one-term courses covering in depth such topics as radiosotope production, neutron activation analysis, neutron radiography, radiosotope power generating systems and tracer applications current in engineering research and development.


699. Research.

III. If a student does not select ROTC as a major or minor, ROTC credits may, at the discretion of the college and the department, be applied toward the elective requirement.

For specific courses and programs see also Air Force Aerospace Studies, Military Science, and Naval Science.

Philosophy

Richard J. Van Iten, Chairman of Department
Professor: Shideler (Emeritus).
Associate Professors: Hollenbach, Solomon.
Assistant Professors: Alexander, Elrod, Harder, Kottman, Kupfer, Robinson.

Undergraduate Study

For the undergraduate curriculum in sciences and humanities, with major in philosophy, leading to the degree Bachelor of Arts, see Sciences and Humanities, Curriculum.

Philosophy is the study of the dominant ideas, values, and ways of thinking that control the specialized search for knowledge, and which underlie cultural, social, and political processes. The first contribution of philosophical study is to broaden the student's educational experience and to facilitate more effective participation in decision making. Introductory courses in philosophy and religion survey dominant ideas as they apply to all fields of knowledge. Advanced courses examine in depth more specific topics in the philosophical and religious traditions of both Western and Oriental cultures.

An undergraduate major in philosophy should have a broad background in the sciences and humanities. The major program includes a thorough acquaintance with the history of philosophy and further concentration in historical and systematic issues, or logic and philosophy of science, or religion.

An undergraduate major in philosophy can prepare the student for graduate study in philosophy or theology, and also for further study of law, history, political science, political and social theory, and literature.

Graduate Study

The department offers courses for graduate minor credit in philosophy as supporting work to other fields.

Open to graduate students for minor credit only:
200. Introduction to Study of Religion. (3-0) Cr. 3 or (3-1) Cr. 4. F.W.S.S. Introduction to the study of the phenomena of religion, and the religious experiences of mankind. Archaic, classical, and contemporary forms, patterns, institutions, and problems of religion. Optional fourth credit entails guided research or other complementary study.

201. Introductory Ethics. (3-0) Cr. 3 or (3-1) Cr. 4. F.W.S.S.SII. Historical and critical introduction to principal ethical systems. Concepts of the nature of good, right, and duty. Standards of public and private action. Optional fourth credit entails guided research or other complementary study.

200. Introduction to Philosophy. (3-0) Cr. 3 or (3-1) Cr. 4. F.W.S.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 on our philosophical tradition and upon critical standards of judgment. Optional fourth credit entails guided research or other complementary study.

270A, 270B. Introductory Logic. (3-0) Cr. 3 or (3-1) Cr. 4 each. 270A: F.S.S.II; 270B: F.W.S.S.SII. 270A: In formal logic and introduction to scientific reasoning. 270B: Informal and formal logic. Optional fourth credit entails guided research or other complementary study.

310. Ancient Philosophy. (4-0) Cr. 4. F. Prerequisite: 260. Greek and Roman philosophy. Examination of original material in Greek and Hellenistic philosophy, including pre-Socratics, Plato, Aristotle, Stoic, Epicurean, sceptic, Neoplatonic schools, and early Christian philosophy to Augustine.

311. Medieval and Renaissance Philosophy. (4-0) Cr. 4. W. Prerequisite: 260. Examination of original materials in medieval and Renaissance philosophy, including those of medieval Christian, Jewish, and Muslim philosophers and representative figures of the later humanistic tradition.

312. Early Modern Philosophy. (4-0) Cr. 4. S. Prerequisite: 260. Sixteenth- and seventeenth-century philosophy. Examination of original materials in early modern philosophy from the late Renaissance and Reformation to Descartes, Leibniz, Spinoza, and Locke.

313. Late Modern Philosophy. (4-0) Cr. 4. F. Prerequisite: 260. Examination of original materials of eighteenth-century philosophy, including such writers as Bayle, Berkeley, Hume, and Kant.

314. Nineteenth-Century Philosophy. (4-0) Cr. 4. W. Prerequisite: 260. Examination of original materials of writers such as Hegel, Schopenhauer, and Nietzsche.

315. Recent and Contemporary Philosophy. (4-0) Cr. 4. S. Prerequisite: 260. Examination of key problems in the history of philosophy by recent and contemporary analytic and pragmatist philosophers such as James, Dewey, Peirce, Wittgenstein, Ryle, Strawson, and Wisdom.

321. The Old Testament. (4-0) Cr. 4. F. Prerequisite: 200. Major books in the Old Testament within the framework of their historical background with particular attention to the development of the great religious and ethical ideas.


330. Aesthetics. (4-0) Cr. 4. W. Prerequisite: 260. An examination of some philosophical problems that arise in interpreting and evaluating the arts with particular attention to some representative theories of the nature of art, artistic creation, aesthetic experience, standards of taste, and criticism.

351. Religions of Western Asia. (4-0) Cr. 4. F. Prerequisite: 200 or 260. Introduction to the ancient religions of Mesopotamia and the Mediterranean basin with emphasis on Zoroastrianism, Judaism, and Islam. Special attention to beliefs, rituals, and philosophical aspects.

352. Religions of Southern and Southeastern Asia. (4-0) Cr. 4. W. Prerequisite: 200 or 260. Introduction to the basic religious patterns, teachings, and philosophies of Indic religions: Hinduism, Theravada Buddhism, Jainism, Sikhism.

353. Religions of East Asia. (4-0) Cr. 4. S. Prerequisite: 200 or 260. Introduction to the religions and philosophies of China, Tibet, and Japan. Confucianism, Taoism, Shinto, and the schools of Mahayana Buddhism such as Amida and Zen.


357. Philosophy of Religion. (4-0) Cr. 4. S. Prerequisite: 260. Application of principles of philosophical method to basic issues of religious belief, emphasizing problems in non-Christian religions. Fourth credit may include study of religion and science, skeptical attacks upon religion. Illustrative material drawn from both Christianity and non-Christian world religions.

365. Existentialism and Phenomenology. (4-0) Cr. 4. F. Prerequisite: 260. Systematic examination of the views of such existentialists and phenomenologists as Husserl, Heidegger, Sartre, Camus, Kierkegaard, Marcel, and Jaspers.

370. Symbolic Logic. (4-0) Cr. 4. S. Introduction to propositional and predicate calculus as well as intuitive set theory. Some applications to philosophy and foundations of mathematics.

390. Philosophy of Science. (4-0) Cr. 4. W. Prerequisite: 260. Consideration of such problems as the nature of scientific explanation, confirmation of scientific theories, the character of observation, the justification of induction, and the constitution of scientific revolutions.

431. Seminar: Value Theory. (4-0) Cr. 4 each time taken, maximum of 8 credits. S. Prerequisite: 251. Theoretical and normative issues in ethics, aesthetics, religious thought, or political philosophy.

455. Seminar: Contemporary Theological Issues. (4-0) Cr. 4 each time taken, maximum of 8 credits. S. Prerequisite: 200 or 260. Examination of selected issues in contemporary theology, including Protestant, Roman Catholic, and Jewish.

462. Seminar: Epistemology and Metaphysics. (4-0) Cr. 4 each time taken, maximum of 8 credits. F. Prerequisite: 300 or 311. Issues in epistemology and metaphysics. Topics vary each time offered.

475. Seminar: Issues in Religious Studies. (4-0) Cr. 4 each time taken, maximum of 8 credits. F. Prerequisite: 200 or 260. Examination of problems such as the following: mysticism, East and West; selfishness in Eastern and Western religions; methodology in the study of religion; religion and culture; problems in the critical study of religious texts.

485. Seminar: Philosophical Analysis. (4-0) Cr. 5. W. Prerequisite: Twenty credits in philosophy; permission of instructor. Topics selected from the main areas of philosophy to develop students' ability to do systematic philosophical analysis. Required of all undergraduate philosophy majors.

490. Special Problems. Cr. 2 to 4 each time taken. Prerequisite: Six credits in philosophy; permission of instructor. Approval of department head must be obtained prior to registration. Guided reading and research on special topics selected to meet needs of advanced students. H. Honors.
Physical Education for Men

James P. Reid, Head of Department

Professors: Menze, Nichols, Schmidt (Emeritus), Schneider, Timm.
Associate Professors: Dickinson, Frye, Gagnier, Hutchison, Kidd, McGuire, Reading, Sutherland.
Assistant Professors: Barland, Cooney, John, Majors, McCullough, Murray, Steel.
Instructors: Dale Anderson, Leslie Anderson, Avezzano, Bennett, Bergan, Block, Bouscilis, Dyar, Fiat, Gaarde, Greene, Guydon, Haffner, Kephart, Kepach, Marcum, Murdoch, Randall, R monster, Roper, Schroeder, Sherrill, Smith, Symons.

Undergraduate Study

For the undergraduate curriculum in Sciences and Humanities, with major in physical education for men, with option in leisure services, leading to the degrees Bachelor of Science or Bachelor of Arts in physical education for men, see Sciences and Humanities. Curriculum.

The major in physical education for men prepares the student to teach physical education and coach in secondary schools, or for professional work in a wide variety of related areas. All majors in physical education must complete the following courses: 200, 205, 212, 320, 330, 359, 420, and 12 credits in courses numbered 105 through 158. In addition to the above, students who wish to prepare for teaching physical education and coaching athletics in secondary schools must satisfy both the Professional Education and Area of Specialization requirements in the College of Education. (See College of Education.)

The option in leisure services prepares the student to enter the field of leisure services in local, state, or national public and private agencies serving the leisure interests and needs of the general population; or, of special groups such as the elderly, ill or disabled, and youth. All students selecting the option in leisure services should complete the following courses, including 15 credits of practicum (field experience) assignments: 201, 283, 350, 351, 353, 383, and 483. In addition, specific courses in other related areas such as hygiene, outdoor recreation resources, landscape architecture, sociology, political science, and psychology should be included.

The department also provides a basic instruction program, a coaching endorsement program (see College of Education), and administers a competitive program in intramural sports and sport clubs.

The intramural program provides opportunity for the student to participate in many competitive sports: archery, baseball, basketball, billiards, chess, fencing, golf, handball, ice hockey, horseshoe pitching, indoor and outdoor track, softball, swimming, table tennis, tennis, touch football, volleyball, and wrestling.

Graduate Study

The department offers courses for graduate minor credit in physical education for men and in leisure services as supporting work to other fields. Courses for graduate minor credit: PEM 359, 420, 492, 494; LS 353.

Courses Primarily for Undergraduate Students

Physical Education

105. Aerobic Conditioning. (0-2) Cr. 1. F.W.S.
108. Canoeing. (0-2) Cr. 1. F.S.
110. Prescribed Individual Activities. (0-2) Cr. 1. F.W.S. Prerequisite: Prescription of Student Health Services. Offered on satisfactory-fail basis only.
111. Beginning Swimming I. (0-2) Cr. 1. W.S. S.S.
112. Beginning Swimming II. (0-2) Cr. 1. W.S. S.S.
113. Water Polo and Related Sports. (0-2) Cr. 1. W.S.
114. Life Saving. (0-2) Cr. 1. W.S. S.S.
116. Water Safety. (0-2) Cr. 1. W.S. S.S. Leads to certification as a Red Cross water safety instructor.
118. Springboard Diving. (0-2) Cr. 1. F.W.S.
118. Square Dance. (F.E.W. 118) See Physical Education for Women.
120. Introduction to Dance. (F.E.W. 120) See Physical Education for Women.
122. Basketball. (0-2) Cr. 1. W.
125. Volleyball I. (0-2) Cr. 1. F.W.S.
126. Volleyball II. (0-2) Cr. 1. W.S. Prerequisite: 125.
131. Beginning Swimming I. (0-2) Cr. 1. W.S.
132. Advanced Swimming. (0-2) Cr. 1. W.S. Prerequisite: 131.
133. Fencing I. (0-2) Cr. 1. F.W.S.
134. Fencing II. (0-2) Cr. 1. W.S. Prerequisite: 133.
135. Wrestling I. (0-2) Cr. 1. F.W.
136. Wrestling II. (0-2) Cr. 1. F.W. Prerequisite: 135.
137. Judo. (0-2) Cr. 1. F.W.S.
141. Archery. (0-2) Cr. 1. F.W.S. S.S.
142. Badminton. (0-2) Cr. 1. F.W.S.
144. Batcasting. (0-2) Cr. 1. F.S.
145. Batcasting Crafts. (0-2) Cr. 1. F.W. Prerequisite: 144.
147. Bowling. (0-2) Cr. 1. F.W.S.
149. Golf I. (0-2) Cr. 1. F.S. S.S.
150. Golf II. (0-2) Cr. 1. F.W.S. S.S. Prerequisite: 149.
151. Gymnastics I. (0-2) Cr. 1. F.W.S.
152. Gymnastics II. (0-2) Cr. 1. F.W. S.S. Prerequisite: 151.
155. Handball. (0-2) Cr. 1. F.W.
165. Tennis I. (0-2) Cr. 1. F.S. S.S.
166. Tennis II. (0-2) Cr. 1. F.W.S. S.S. Prerequisite: 165.
157. Paddleball and Squash. (0-2) Cr. 1. F.W.
COURSES AND PROGRAMS

158. Weight Training. (0-2) Cr. 1 F.W.S.

190. Sports Participation. Cr. 1 each Transfer to freshman and varsity sport squads upon permission of coach.

A. Baseball F.S.
B. Basketball F.W.
C. Football F.S.
D. Golf F.S.
E. Gymnastics F.W.
F. Swimming, F.W.
H. Tennis F.S.
I. Track, F.W.S. (Maximum of two per year).
J. Wrestling F.W.
K. Athletic Conditioning. F.W.S.

200. Introduction to Physical Education. (3-0) Cr. 3.

S. Prerequisite: Physical education major, freshman or sophomore classification. Basic philosophy and objectives of physical education; essential interests, abilities, personal characteristics, and professional qualifications; planning for careers as qualified teachers.

205. Supervised Teaching in Physical Education. (1-2) Cr. 1 F.W.S. Prerequisite: 200, sophomore classification. Pre-student-teaching experience. Offered on satisfactory-fail basis only.

212. Gymnastics Techniques. (1-4) Cr. 3. F.S. Prerequisite: 200. Techniques, including tumbling, apparatus, and methods of teaching.

230, 231, 232. Sports Officiating. (1-2) Cr. 2 each.


305. Supervised Teaching in Physical Education. (1-2) Cr. 2. F.W.S.SS. Prerequisite: 205, classification in 497. Pre-student-teaching experience.


*314. Football Techniques and Theory. (2-6) Cr. 5. W. S.SS. Prerequisite: Junior classification. Fundamental skills, rules, coaching methods, and theory.

*315. Basketball Techniques and Theory. (2-6) Cr. 5. F.W. Prerequisite: Junior classification. Fundamental skills, rules, coaching methods, and theory.

*316. Track and Field Techniques and Theory. (2-6) Cr. 5. F.S.SS. Prerequisite: Junior classification. Fundamental skills, theory, coaching methods, rules, and officiating.

*317. Baseball Techniques and Theory. (2-6) Cr. 5. W. S. Prerequisite: Junior classification. Fundamental skills, rules, coaching methods, and theory.

*318. Swimming Techniques and Theory. (2-6) Cr. 5. S. Prerequisite: Junior classification, background in competitive swimming. Fundamental skills, rules, coaching methods, and theory.

*319. Wrestling Techniques and Theory. (2-6) Cr. 5. F. Prerequisite: 185, junior classification. Fundamental skills, rules, coaching methods, and theory.


330. Principles of Physical Education. (3-0) Cr. 3. F.S. Prerequisite: 205. Educ 204, junior classification. Influence of prevailing philosophies on current principles and practices.

340. Organization and Administration of Intramural Sports. (3-0) Cr. 3. W.SS. Prerequisite: 330. Conduct and direction with special emphasis on the secondary level.

358. Biomechanics of Human Movement. (3-3) Cr. 4. F.W.S. Prerequisite: Zool 237. Analysis of human movement applied to physical education activities.

405. Supervised Teaching in Physical Education. (1-2 and arr.) Cr. 3. F.W.S.SS. Prerequisite: 305, 497. Pre-student-teaching experience.

*417. Student Teaching in Athletics. Cr. var. F.W.S. Prerequisite: Credit or classification in D St 417 and and 320, eight credits in coaching endorsement courses. Observation, evaluation of coaching, planning, and coaching in interscholastic athletics. Offered on a satisfactory-fail basis only.

*420. Physiological Foundations of Coaching. (3-0) Cr. 3. F.W. Prerequisite: Zool 356, junior classification. Circulatory and respiratory adjustments, metabolism, nutrition, drugs, conditioning, strength, and endurance training.

460. Special Problems. Cr. var. Prerequisite: 23 grade-point average, senior classification, and permission of department head.

A. Coaching Sports.
B. Physical Education.
H. Honors.

*492. Problems of Coaching. (6-0) Cr. 5. F.W. Prerequisite: Senior classification, qualification for practice teaching. Factors necessary for effective human relations; current trends involving administrative policies and procedures in athletic programs in secondary schools.

494. Physical Education Curriculum: Design and Administration. (5-0) Cr. 5. W.S.SS. Prerequisite: 497, senior classification. Physical education curriculum and current administrative policies, procedures, and practices in secondary schools.

498. Tests and Measurement in Physical Education. (2-6) Cr. 3. S. Prerequisite: Stat 101, senior classification. Tests and measurement which aid in classification, aptitude prediction, and evaluation of performance.

497. Methods of Teaching Physical Education. (3-0) Cr. 3. W.S. Prerequisite: 330, credit or classification in Educ 305A. Special methods of teaching physical education activities.

Leisure Services

201. Leisure and Recreation: Concepts and Services. (3-2) Cr. 4. F.W.S.SS. Concepts of leisure and recreation in people's lives; historical development and current significance; the recreation and park movement in the U.S.; professional rules of the recreator and opportunities for service.

283. Practicum in Leisure Services. Cr. 3. W.F.W.S.SS. Prerequisite: 201, sophomore classification. Observation and practice in established leisure programs and services offered by community agencies, hospitals, or other institutions. Offered on satisfactory-fail basis only.

360. Leadership, Services, and Programs. (3-4) Cr. 5. W. Prerequisite: 201. Principles and practices in recreation leadership, development, and services.

351. Outdoor Recreation. (2-4) Cr. 4. F.S. Prerequisite: 201. Development of appreciation for the out-of-doors; methods of leadership in camping; backpacking and canoeing; camping skills.

353. Administration of Leisure Services. (5-0) Cr. 5. S. Prerequisite: 363, junior classification. Principles and practices of administering leisure programs and services.

385. Practicum in Leisure Services. Cr. 3. W.S.S.SS. Prerequisite: 285, 360. Observation and practice in established leisure programs and services offered by community agencies, hospitals, or other institutions. Offered on satisfactory-fail basis only.

483. Practicum in Leisure Services. Cr 9. S.S. Prerequisite: 383, senior classification. Full-time work experience combined with study for a minimum of 6 to 10 weeks in leisure programs and services of community agencies, hospitals, or other institutions.

490. Special Problems. Cr. var. Prerequisite: Junior classification, permission of instructor.

A. Topics in various aspects of leisure.
H. Honors.

*Courses leading to Coaching Endorsement.
Physical Education for Women

Barbara E. Forke, Head of Department

Professors: Guiot, Toman.
Assistant Professors: Conover, Keenan, Mathes, McDonald, Chemister, Puhl, Rupnow, Wood.

Undergraduate Study

The department of physical education for women offers work for the Bachelor of Science degree with a major in physical education. The major in physical education with the dance option is also offered. A Bachelor of Science degree in physical education may be received through the College of Home Economics or the College of Sciences and Humanities. For undergraduate curricula in physical education for women, see Home Economics, Curricula. Group requirements for a Bachelor of Science degree through the College of Sciences and Humanities are listed under College of Sciences and Humanities, Curriculum.

Curricula in physical education for women prepare students to teach physical education and/or dance. Students may work toward kindergarten through twelfth grade certification or toward secondary certification in either of the above areas. To be accepted in the teacher education program, students must be approved by the departmental committee on selection and the College of Education Committee on Academic Standards. For the teacher education program, including certification requirements, see College of Education.

Although the main purpose of the professional programs in physical education and dance is to prepare teachers, an undergraduate degree in physical education provides the background for work in related areas such as recreation. The department offers a wide selection of beginning, intermediate, and advanced courses in the areas of aquatics, dance, and sports. These courses may be taken as electives and/or to fulfill the requirement in physical education. Adapted physical education is provided, according to individual needs, for students who cannot participate in a regular program of activities. Any non-major may elect to take physical education on a pass-not pass basis (see Chart for details).

Graduate Study

Open to graduate students for minor credit only: 359, 370, 455, 480.

Courses Primarily for Undergraduate Students

Aquatics

Beginning Courses


Intermediate and Advanced Courses

102. Swimming II. (0-3) Cr. 1. F.W.S.68. Prerequisite: 101 or equivalent skill. Beginning swimming course. Emphasis on front crawl, elementary back stroke, and side stroke. Fee.

103. Swimming III. (0-3) Cr. 1. F.W.S.68. Prerequisite: 102 or equivalent skill. Perfection of basic strokes. Introduction to breast stroke. Fee.

104. Basic Canoeing. (0-3) Cr. 1. F.W.S. Prerequisite: Ability to stay afloat ten minutes in deep water while clothed. Instruction and practice in basic strokes and skills needed for the safe handling of a canoe. Fee.

Dance

Beginning Courses

117. Folk Dance. (P E M 117) (0-2) Cr. 1. F.W.S
118. Square Dance. (P E M 118) (0-2) Cr. 1. F.W.S.

Intermediate and Advanced Courses

220. Modern Dance Composition. (0-3) Cr. 1 each time taken. F.W.S. Prerequisite: 120, or at least two years of high school modern dance, or six years of ballet. Theory and practice of creative skills involved in solo and group composition.

222. Techniques of Modern Dance. (0-3) Cr. 1 each time taken. F.W.S. Prerequisite: 120, or at least two years of high school modern dance, or six years of ballet. Instruction and practice in intermediate and advanced modern dance techniques.

233. Advanced Modern Dance. (0-3) Cr. 1 each time taken. F.S. Prerequisite: 220, 222, Instruction and practice of advanced modern dance technique, composition and improvisation.
Individual and Advanced Courses

228. Intermediate Volleyball. (0-3) Cr. 1. W.S. Prerequisite: Previous experience in volleyball.

227. Intermediate Basketball. (0-3) Cr. 1. W. Prerequisite: 151A or previous experience in basketball.

Elective Courses Open to All Students

356. Camping and Outdoor Education. (3-0) Cr. 3. S. Prerequisite: Three credits required physical education. Introduction to camping objectives, organized camp programs, methods of leadership, and knowledge of camp craft skills, culminating in cookouts and a weekend camp-out.

378. Methods of Teaching Aquatics. (2-1) Cr. 2. W. Prerequisite: 103 or equivalent skill. Theory and techniques involved in the teaching of aquatics including instructional, recreational, performing, and competitive programs. Open to prospective swimming specialists in school, camp, or recreational swimming programs. Fee.

380. History and Philosophy of Dance. (0-3) Cr. 3. Alt. S., offered 1974. Study of the history of dance from early to modern times with emphasis on the theories and philosophies of contemporary modern dance, dancers, and dance educators.

382. Advanced Studies in Dance. Cr. 1 to 3 in any one quarter with a maximum of 9 credits. F.W.S. Prerequisite: Permission of instructor. 382C requires advanced proficiency in performing ability.

A. Production.
B. Choreography.
C. Performance.
D. Related Arts.

Designed to meet special interests and talents of students and include both group and independent study in various aspects of dance as a performing art.

456. Physical Education for Exceptional Children. (2-1) Cr. 3. S. Prerequisite: Psych 230. Objectives and scope of physical education for exceptional children, excluding the gifted. Emphasis on adaptation of activities, methods and program planning. Opportunity for observation. Two all-day field trips.

470. Physical Education for Children. (2-3) Cr. 3. F.W.S. Prerequisite: C D 225. Philosophy, objectives, and program of physical education in the elementary school. Methods of teaching basic movement, rhythmic activities, games, and self-testing activities. Open to elementary education majors.

Professional Program Courses

150. Fundamentals of Individual-Dual Sports. (9-3) Cr. 1 each. F.W.S. Skills, rules, strategy and techniques of selected activity.

A. Archery.
B. Badminton.
C. Tennis.
D. Golf.

151. Fundamentals of Team Sports. (9-3) Cr. 1 each. F.W.S. Skills, rules, strategy and techniques of selected activity.

A. Basketball.
B. Volleyball.
185. Fundamentals of Educational Modern Dance. (0-3) Cr. 1. F.W.S. Instruction and practice in the fundamentals of modern dance and basic concepts of composition.

190. Perspectives of Physical Education. (2-2) Cr. 3. F.W.S. Nature and scope of physical education as a profession.

220. Creative Teaching of Physical Education. (4-0) Cr. 4. F.S. Prerequisite: 259. Principles and current practices applied to teaching gymnastics and/ or extracurricular activities.


260. Physical Education in the Elementary School. (3-4) Cr. 5. F.W.S. Prerequisite: 259. Relationship of elementary school physical education to the total educational program. Sequential development of motor skills and activities from kindergarten through sixth grade. Principles and methods of teaching basic movement, rhythmic activities, games and sports, and gymnastics to elementary school children.

270, 271. Officializing. (1-3) Cr. 2 each. F.W. Prerequisite: 270: 161B; 271: 151A. Techniques and practice in officiating physical education activities. 270: Volleyball; 271: Basketball.

359. Biomechanics of Human Movement. (P E M 359) (3-3) Cr. 4. F.W. Prerequisite: Zool 327. Biomechanical kinesiology applied to physical education activities.

360. Socio-Psychological Effectors of Movement. (4-0) Cr. 4. W.S. Prerequisite: Psych 101; Soc 134 or Anthro 111. Individual differences in psychological characteristics and behavior in relationship to sports and dance performance, and interrelationships between sport and various social units and processes. Focuses on the influence of personality and sociological variables upon the selection and performance of movement experiences.


375. Teaching Physical Education. (3-4) Cr. 4. F.S. Prerequisite: 255. Principles and current practices of teaching physical education.

378. Principles and Current Practices in Teaching A. Gymnastics; B. Modern Dance. (0-4) Cr. 2 each. W.S. Prerequisite: A: 251, 259; B: 165, 259. Methods and techniques of teaching gymnastics and/or beginning modern dance.

385. Rhythmic Form and Analysis. (1-4) Cr. 3. F.S. Prerequisite: 165. An analytical study of the rhythmic structure inherent in all physical education activities. Special emphasis on recreational dance forms.

386. Creative Teaching of Dance. (2-2) Cr. 3. Alt S., offered 1976. Prerequisite: 165, 261A. Teaching of dance as a creative art with emphasis on the choreographic process.

390. Professional Relations. (1-0) Cr. R. W. Prerequisite: Admission to the teacher education program. Personal, professional, and public relations in education.


420. Organization of Physical Education Programs. (3-0) Cr. 3. F.W.S. Prerequisite: 255. Principles and current practices applied to problems of organization and administration of instructional and extracurricular programs in physical education.

440. History and Philosophy of Physical Education. (3-0) Cr. 3. S. Prerequisite: 190. Development of physical education from Greek to modern times and the relationship of prevailing philosophies to physical education.

452. Evaluation in Physical Education. (2-2) Cr. 3. F.S. Prerequisite: Senior standing. Survey of principles underlying process of evaluation. Review of selected test and measurement procedures and tools within the field of physical education.

460. Physical Education for the Physically Handicapped. (3-2) Cr. 3. W. Prerequisite: Psych 230. Organization of an adapted physical education program. Study of specific handicapping conditions in terms of etiology, description and potential for movement and activity. Activities and specific exercises aimed at the rehabilitation of the individual.

490. Physiology of Exercise. (3-3) Cr. 4. W.S. Prerequisite: Zool 166. Physiological basis of human performance; effects of physical activity on body functions.

495. Seminar in Physical Education. (2-0) Cr. 2 & Prerequisite: Senior standing.

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**Physics**

Richard G. Barnes, Chairman of Department


*Associate Professors:* Beavers, Clem, Cook, Fuchs, Hodges, Leacock, Peterson, Sinha, Stanford, Weber, Williams.

*Assistant Professors:* Anderson, Bureau, Buttram, Cooper, Crawley, Dean, Grossman, Morrison, Ross, Schick, Stassin, Traylor, Wohl, Young.

*Instructors:* Chesser, Dixon, Eitter.

### Undergraduate Study

For the undergraduate curriculum in sciences and humanities, major in physics, leading to the degree Bachelor of Science, see *Science and Humanities, Curriculum.*

Physicists seek to understand and apply the fundamental laws describing the physical universe. Students may choose physics for their major subject both as a challenging approach to personal development, or as a step towards a career as a professional physicist. Graduates seeking a professional career in physics have many fields open to them: as teachers of physics, as research physicists, and as technical
personnel and administrators in federal, academic, and industrial laboratories. Although many opportunities exist for men and women who terminate their studies with the bachelor’s degree, students who meet the necessary scholastic standards usually continue their studies in a graduate college, where they have ample opportunities to explore and contribute to the most recent developments in the subject.

Three programs are offered for undergraduate physics majors: a standard physics major program, a program with emphasis on astronomy and astrophysics, and a program for those students planning to enter secondary school teaching. Normally, all students would take the basic courses: 221, 222, 223P, 331, 332.

For students in the standard program the minimum recommended courses, in addition to the basic courses, include 361, 362, 363, 364, and 365. In addition the student should elect 6 credits of 300-level courses; 6 credits of 400- to 500-level courses exclusive of 489, 490, 499; 1 credit of 499, and 3 credits from 311 or 411. The latter 3 credits may be part of the 6 credits at the 300 level, or 6 credits at the 400 to 500 level, respectively. Electives may be chosen from 304, 310, 311, 344, 345, 346, 394, 411, 480, 481, 482, 483, 496.

Students electing the astronomy and astrophysics program would normally take, in addition to the basic courses, 344, 345, 346, 411; 3 credits from 480, 481, 482, 483, or 484; 1 credit of 499; and the electrical engineering courses EE 558A, 558B (radio astronomy). Such students may choose electives from those courses listed above.

Students planning to enter secondary school teaching will usually complete the following courses which represent minimal requirements for a teaching certificate: 301, 302, 303 (if 331, 332 are not taken), 344, 345, 354, 394 or 310, 311, 361, 3 credits of 399, 1 credit of 499.

As supporting studies, undergraduate majors find the following courses desirable: Math 130, 131, 132, 213, 233, 307, 321, 322, 409, 410, 411; Chem 141, 142, or 147, 148; Com S 201. Course work equivalent to Math 120 should be completed in high school if possible so that the entering student can begin with Math 130.

Graduate Study

The department offers work for the degree Master of Science with major in physics and for the degree Doctor of Philosophy with major in physics, or in the particular areas, astrophysics, elementary particle physics, nuclear physics, and solid state physics, and minor work to students majoring in other departments.

Facilities of the department and in the Ames Laboratory are available for both theoretical and experimental research.

Students with bachelor’s degrees in physics from other institutions ordinarily will qualify for graduate study here provided they have satisfactorily completed course work similar to that suggested for undergraduate physics majors at this university. In some cases, additional instruction at the intermediate level may be required.

The degree Master of Science in physics is offered both with and without thesis. In either case, the basic requirements are the same: at least 45 credits of acceptable graduate work must be completed, not less than 33 of which must be in physics and not less than 9 from other departments. At least 17 of the credits in physics must be in courses at the 500- or 600-level exclusive of 595 and 699. Students choosing a degree without thesis should take one credit per quarter of 595, and may not apply any credits of 699 toward the degree. Foreign language is not required.

Each candidate for the Doctor of Philosophy degree is required to teach one year of elementary physics and to acquire adequate knowledge of one of three foreign languages: French, German or Russian. A score of 525 on the Educational Testing Service Language Examination or a passing grade in an undergraduate course which represents the completion of 18 quarter credit hours is considered adequate.

In addition to course work in his major area a candidate must take 18 minor credit hours outside this area, not less than 9 of which must be from other departments.

Open for graduate minor credit only: 304, 310, 311, 344, 345, 346, 354, 355, 364, 365, 394, 411, 447, 448, 449, 496.

Courses Primarily for Undergraduate Students

100. Introductory Seminar. (1-1) Cr. 1. F. A survey of current research in the physics department, and of non-research-oriented careers in physics. For physics majors.

*101. Foundations and Frontiers of Physics. (4-0) Cr. 4. F.W.S. An essentially nonmathematical survey of the principal areas of physics, both classical and modern, emphasizing the scope, methods, and goals of physics, and its relation to other fields of human activity.

*106. Elementary Physics. (4-2) Cr. 4. F.W.S.S.S. Basic topics in mechanics, nuclear energy, heat, electricity, and light, with emphasis on everyday applications.

111, 112, 113. General Physics. (2-4) Cr. 4 each. 111: F.W.; 112: W.S.; 113: F.S. Prerequisite: One-and-one-half units of high school algebra, one unit of geometry, and one-half unit of trigonometry. General background in physical concepts and principles for students who do not plan advanced study in physics or engineering. 111: Mechanics, heat. 112: Electricity and magnetism, wave motion. 113: Topics from relativity, quantum theory, nuclear and solid state physics.

151, 152, 153. Introduction to Astronomy. (3-0) Cr. 3 each. Yr. Prerequisite: One-and-one-half units of high school algebra, one unit of geometry, and one-half unit of trigonometry. For students who do not plan advanced study in physics or astronomy. 151: Coordinate systems, planetary motion, astronomical instruments, eclipses, moon

*The department recommends that credit in both 101 and 106 not be applied toward graduation.
198. Physics of Music (2-0) Cr. 2 F. Harmonic series, wave properties, resonance, tone quality, musical scales, room acoustics, instrument design, sound wave synthesis, and electronic music. For nonphysics students with musical interest.

231, 232, 233. Introduction to Classical Physics (5-0) Cr. 5 each. F.W.S.S. Prerequisite: 231. Credit or classification in Math 121 or 130; 232: 221 and credit or classification in Math 122 or 131; 233: 222 and completion of Math 122 or 131. For engineering and science majors.

234. Quantum Mechanics (3-0) Cr. 3. F. Prerequisite: 223, Math 213. Introduction to quantum mechanics, emphasizing basic conservation laws. 232: Oscillations and waves, thermal physics, static electric fields, simple DC circuits. 233: Static magnetic fields, time-dependent electromagnetic fields, electromagnetic waves, optics. 223P: For physics majors and qualified students. Seeking strong emphasis in physics includes one laboratory per week.

301, 302, 303. Modern Physics (3-0) Cr. 3 each. Yr. Prerequisite: 223, credit or classification in Math 213. Primarily for undergraduate students in engineering. Special theory of relativity, quantum effects, basic concepts of quantum mechanics, atomic spectra, X-rays, solid state physics, and nuclear physics.

304. Thermodynamics (3-0) Cr. 3. W. Prerequisite: 223, Math 213. Concepts of temperature, entropy, and other important concepts of classical thermodynamics. A presentation of important advances in applications to macroscopic properties of matter.

310. Undergraduate Electronics Laboratory (6-0) Cr. 3. F. Prerequisite: Credit or classification in 394. Basic properties of electronic components, amplifiers and pulse circuits, feedback.

311. Undergraduate Laboratory (6-0) Cr. 3 each. Yr. Prerequisite: 223, Math 213. Experiments in classical and modern physics. Emphasis upon planning of experimental procedures. A special section is provided for students planning a career in high school teaching.

317, 318, 319. Introduction to Modern Physics (3-2) Cr. 4 each. 317: W.; 318: S. Prerequisite: 223 or 223P; credit or classification in Math 213. For physics majors and qualified students seeking a strong emphasis in physics. 317: Special theory of relativity, invariance of Maxwell's equations, photons. 318: Development of the idea of quantization. Foundations of the quantum theory of microscopic phenomena.


350. Physical Aspects of Environmental Problems (3-0) Cr. 3. W. Prerequisite: 113 or 223; Chem 142 or 148. Application of physical principles to environmental problems and their solutions.


398. Seminar on Secondary School Physics (2-0) Cr. 1. F.W.S. Prerequisite: Permission of instructor. Review of materials and curricula for secondary school physics presented and discussed by members of the class. Required for approval to teach physics in secondary schools.

411. Senior Research Laboratory (0-6) Cr. 3 each time taken. Prerequisite: Permission of instructor. Projects in experimental or theoretical physics directed on a tutorial basis. Projects selected from fields of current research interest in physics. A special section is provided students interested in astronomy or astrophysics. Emphasis on preparation of students for independent research.

447, 448, 449. Modern Physics (3-0) Cr. 3 each. Yr. Prerequisite: 223, Math 322. For students not majoring in physics. 447: Important aspects of classical physics, including classical mechanics, wave motion, and Maxwell's equations; the Schroedinger equation. 448: Application of the Schroedinger equation to the hydrogen atom, the H2 molecule ion, the helium atom, and electrons in a periodic lattice; semiclassical theory of absorption and emission of radiation. 449: Nuclear physics, relativistic energy, mass, momentum. Fundamentals of nuclear fusion and nuclear energy.

450. Undergraduate Research. Cr. 1 to 6 each time taken. F.W.S.S. Prerequisite: Permission of instructor. Experimental or theoretical research under staff supervision.

460. Undergraduate Research Seminar (1-0) Cr. 1 to 6 each time taken. F.W.S.S. Prerequisite: Permission of instructor. Experimental or theoretical research under staff supervision.


482. Statistical and Solid State Physics (3-0) Cr. 3. W. Prerequisite: 383. Introduction to statistical mechanics and to the transport properties, magnetic properties, and the band theory of solids.


484. Elementary Particle Physics (3-0) Cr. S. Prerequisite: 363. Current status of modern physics. Elementary particles, the quark model; weak, electromagnetic, and strong interactions; scattering and decays of elementary particles; optical and particle-exchange models of scattering.

486. Tutorial Seminar. (1-0) Cr. 1 each time taken. F.W.S. Prerequisite: Permission of instructor. For junior and senior physics majors. Topics of interest in physics discussed in small groups. Offered on satisfactory-fail basis only.

490. Special Problems. Cr. 1 to 4 each time taken. Prerequisite: Permission of instructor. H. Honors.

496. Optics (3-0) Cr. 3. F. Prerequisite: 385. Physical optics: interference, diffraction, scattering, polarization, coherence.
Courses Primarily for Graduate Students, major or minor, open to qualified undergraduates

509. Relativity and High Energy Astrophysics. (3-0) Cr. 3. Alt. S., offered 1975. Prerequisite: Permission of instructor. General relativity, cosmology, neutron stars, black holes, pulsars, quasars, 3K background radiation, ultraviolet and gamma-ray celestial sources.

510. Observational Astrophysics. (1-4) Cr. 3. F.S. Prerequisite: Permission of instructor. Techniques of astrophysical data acquisition, reduction, and analysis, using photoelectric, spectrographic, and photographic equipment on a telescope.

511, 512, 513. Solid State Physics. (3-0) Cr. 3 each Yr. Prerequisite: 304, 482. Crystal symmetry, free electron model, band theory of solids, Fermi surface, transport properties, superconductivity, ferromagnetism.

524, 525, 526. Nuclear Physics. (3-0) Cr. 3 each Yr. Prerequisite: 483. Theory of nuclear reactions and alpha, beta, and gamma radioactivity; nuclei; nuclear models. Interaction of charged particles with matter.

531, 532. Thermodynamics, Statistical Mechanics and Kinetic Theory. (3-0) Cr. 3 each. 531: W.; 532: S. Prerequisite: 304, Math 410. The laws of thermodynamics; thermodynamic functions; applications to various systems; phase equilibria; principles of statistical mechanics; the microcanonical, canonical, and grand canonical ensembles of classical and quantum mechanics and their application to physical problems; kinetic theory and equation of state of gases; transport theory; Boltzmann transport equations; Brownian motion and noise.

533. Experimental Techniques in High Energy Physics. (3-0) Cr. 3. S. Prerequisite: Permission of instructor. Bubble chamber techniques, design and use of beam transport systems, characterizations of protons and other particles, spark chambers, and counter techniques.

537, 538, 539. High Energy Physics. (3-0) Cr. 3 each Yr. Prerequisite: Credit or classification in 591, 592, 593 respectively. Special theory of relativity, reaction kinematics, basic properties of elementary particles and reactions, SUS and other classification schemes.

555, 556, 557. Astrophysics. (3-0) Cr. 3 each Yr. Prerequisite: Permission of instructor. 555: Fundamental astrophysical data, measurements, comets, meteors, interplanetary medium, planetary atmospheres and interiors. 556: Stellar spectroscopy, spectral classification, stellar interiors and atmospheres, stellar evolution, eclipsing and spectroscopic binaries. 557: Star clusters, galactic structure, interstellar matter and nebulae, cosmology.

564. Advanced Classical Mechanics. (3-0) Cr. 3. F. Prerequisite: 355 or 362; Math 410. Advanced methods and problems in dynamics. Lagrange and canonical equations, normal coordinates, rigid body mechanics, canonical transformation, Hamilton-Jacobi equations.

571, 572, 573. Advanced Electricity and Magnetism. (3-0) Cr. 3 each Yr. Prerequisite: Math 322, 411. 571, 572: Electrodynamics, magnetostatics, boundary value problems, Maxwell’s equations, electromagnetic fields and wave phenomena in macroscopic media, wave guides. 573: Relativistic physics. Special theory of relativity, motion of charged particles, general theory of electromagnetic radiation, radiation produced by charges moving and in collision, radiation damping.

590. Special Topics. Cr. var. Prerequisite: Permission of instructor.

591, 592, 593. Quantum Physics. (3-0) Cr. 3 each Yr. Prerequisite: 480. Schroedinger theory, representations, approximation methods, time-dependent problems, elementary scattering theory.

595. Tutorial Physics. Cr. var. Prerequisite: Permission of instructor.

Courses for Graduate Students, major or minor


611, 612, 613. Quantum Theory of Solids. (3-0) Cr. 3 each Yr. Prerequisite: 693. 611: X-ray and neutron diffraction; phonon dispersion relations; one-electron theory and band-structure calculations; exchange and correlation. 612: Optical properties; transport properties; conductivity; magnetic phenomena; the Fermi surface and its determination: cyclotron resonance, de Haas-van Alphen effect, ultrasonic attenuation, magnetoresistance. 613: Crystal field theory; magnetic resonance; cooperative phenomena: magnetism, superconductivity.

624, 625, 626. Nuclear Theory. (3-0) Cr. 3 each Yr. Prerequisite: 591, 592, 593: Nuclear models and nuclear matter. 626: Beta decay and nuclear spectroscopy. 626: Nuclear reactions.

637, 638, 639. Fundamental Particle Physics. (3-0) Cr. 3 each Yr. Prerequisite: 593. Relativistic quantum mechanics of particles with any spin, S-matrix theory, applications of quantum electrodynamics, Regge poles, current algebras, applications in theory of weak and strong interactions.

650. Advanced Seminar. (1-0) Cr. 1 each time taken. F.W.S. Topics of current interest.
A. Nuclear Physics
B. Solid State Physics
C. Astrophysics
D. High Energy Physics

660. Advanced Topics in Physics. Cr. 1 to 3 each time taken. F.W.S. Courses on advanced topics and recent developments.
A. Nuclear Physics
B. Solid State Physics
C. Astrophysics
D. High Energy Physics

674, 675, 676. Application of Group Theory to Physics. (3-0) Cr. 3 each. Alt. Yrs., offered 1974-1975. Prerequisite: 593, 674: Theory of groups and group representations. Finite groups, with applications mainly to solid state physics and molecular theory. 675: Theory of continuous groups, with applications mainly to the hyperfine interaction problem in atomic physics and to the rotation group in the representation of particles. Applications especially to the study of the properties of space-time unities. 676: The symmetry properties of space-time unities. Applications especially to the study of particles and to the symmetry properties of space-time unities.

681, 682, 683. Quantum Mechanics. (3-0) Cr. 3 each Yr. Prerequisite: 593. Advanced quantum mechanics, second quantization, relativistic wave equations, symmetry operations, many-particle theory, propagators, S-matrix.

699. Research
Plant Pathology

For description of courses, see Botany and Plant Pathology.

Political Science

Ross B. Talbot, Chairman of Department


Undergraduate Study

For the undergraduate curriculum in sciences and humanities, with major in political science, leading to the degree of Bachelor of Arts, see Sciences and Humanities, Curriculum.

The study of political science is designed to enable the student to become familiar with theories of public values and patterns of political systems—national, regional, and international. A political science major should complete a broad liberal arts program which would maximize opportunities for study in related (social science) disciplines, as well as in the various areas of the humanities. A detailed statement of departmental requirements may be obtained from the departmental office.

Each student majoring in political science will work out with his or her adviser appropriate means for beginning to develop a facility in the use of a research tool. As a minimum, each student should have 12 hours in a research tool, such as a single foreign language or quantitative techniques.

The department has no physical education requirement.

Students majoring in political science may substitute a second major in international studies in place of an optional minor in the College of Sciences and Humanities. See International Studies.

A prelaw undergraduate program may be pursued through a major in political science. For a more complete statement see Preprofessional Study.

Students interested in further courses on Latin America, Africa, and East Asia, should see Distributed Studies, 201-3, 204-6, and 207-9.

Graduate Study

The department offers work for the degree Master of Arts with major in political science and minor work to students majoring in other departments.

The program is designed to enable its graduates to engage in governmental research, enter public service or private industry, pursue further graduate study, or teach. Both thesis and nonthesis options are available. Within either option, a specialization in public administration is possible. This department also has a joint Juris Doctor/Master of Arts program with the Law School of Drake University. In addition, graduate students may wish to work for certification for high school or junior college teaching.

Brochures setting forth the detailed requirements for the degrees within each option, and for the J.D./M.A. degrees, may be obtained from the Political Science office.

Prerequisite to major graduate work in the department is normally the completion of at least 21 quarter credits in political science.

Each student entering the Master of Arts program in political science is expected to have completed one year of a foreign language (equivalent to 12 quarter credits) and a course in basic statistics (equivalent to Stat 101). If this has not been done, the student may remedy the deficiency by passing equivalent courses, for which no graduate credit will be received.

In addition, each student must complete one of the following requirements:

1. Language—Two years of undergraduate instruction (including the one year of foreign language provided above) in a single language, with grades averaging 2.7 (on a 4.0 scale); or, a passing grade in the Educational Testing Service examination.

2. Statistics—Successful completion of Stat 401, Stat 402 is recommended also, but not required. It is permissible to substitute Stat 401 and 402 for Stat 101 and 401, although to do so a student should audit 101 first.

These requirements are only the basic minimums. The student's advisory committee will decide if additional work, in either language or statistics, is necessary.

The department also offers a Master of Arts program, with no language requirement and a choice of a thesis or an internship requirement, to those students who wish to prepare for, or are employed in, government service.

The department also cooperates in the interdepartmental program of industrial relations (see Industrial Relations). Courses open to graduate students for minor credit only: 410, 420, 421, 422, 430, 431, 432, 433, 434, 440, 441, 442A, 442B, 443A, 443B, 444, 445, 446A, 446B, 451, 452, 453, 458, 464, 467, 468, 471, 472, 473, 474, 475, 476.

Courses Primarily for Undergraduate Students

100. Introduction to Political Science, (2-0) Cr. 1. F. General introduction to the discipline; discussion of the several fields within political science; consideration of career opportunities. Offered satisfactory-fail only.

215. American Government, (2-0) Cr. 3. E.W.S. 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. Introduction to Political Philosophy. (4-0) Cr. 4. F.S. Prerequisite: Sophomore classification. Basic issues in past and contemporary political systems, such as freedom, power, justice, security, general welfare, law, and property.

241. Introduction to Comparative Politics. (3-0) Cr. 3. F.W.S. Basic concepts and major theories; application to selected political systems, including nonwestern and communist political systems.

251. Introduction to International Politics. (3-0) Cr. 3. F.W. Traditional concepts of international relations; their alteration by nuclear weapons and the Cold War between the U.S.A. and the U.S.S.R.

290. Special Problems. Cr. var. F.W.S.S.S.
A. Topical and experimental courses.
B. Independent study.
H. Honors.

310. State and Local Government. (3-0) Cr. 3. S. Prerequisite: Three credits in political science. Wiggins. Organization and functions; state regulations and operations; special problems including reorganization of state and local government, consolidation of government areas, financial control, state civil service.

311. Municipal Government and Politics. (3-0) Cr. 3. S. Prerequisite: Three credits in political science. Fitzpatrick, Whitmer. Legal position of municipal corporation, forms of organization, administration of municipal services, problem-solving in municipal government, urban political process, goals for urban America.

320. American Judicial Process. (3-0) Cr. 3. F. Prerequisite: Three credits in political science. Wiggins. Major political philosophers.

330. Introduction to Political Behavior. (3-0) Cr. 3. F.W.S. Prerequisite: 215 or 217 or 230 or 241. Hutter. Behavioral approach to political science; empirical political practices, systems theory and decision making, power, conflicts and coalitions, attitudes and opinions.

331. Introduction to Empirical Political Research. (3-0) Cr. 3. W. S. Prerequisite: Three credits in political science. Hutter. Major types of political science research methods, including polling and surveys, aggregate data, elections and voting, data analysis, machine storage, and statistical treatments.

333. Introduction to Political Analysis. (5-0) Cr. 5. F.W.S. Prerequisite: Three credits in political science. Hutter. Major perspectives of the study of political science; primary emphasis on research theory and methodology.

340. Politics of Developing Areas. (3-0) Cr. 3. S. Prerequisite: 241 or Econ 411. Obrunsole. 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.


410. Iowa Government and Politics. (3-0) Cr. 3. S. Prerequisite: 215 or 217 or 310. Wiggins. An analysis of Iowa government and politics, focusing upon major institutions of government: political parties, interest groups, legislature, supreme court, and chief executive. Role of municipalities and counties as local units of Iowa government.

420. Constitutional Law. (3-0) Cr. 3. F. Prerequisite: 215 or 217; junior classification. Bossa. Development of the United States Constitution through judicial action; influence of public law and judicial interpretations upon American government and society.

421. Civil Liberties. (3-0) Cr. 3. W. Prerequisite: 215 or 217; junior classification. Bossa. American constitutional and statutory guarantees of civil rights. First Amendment rights of conscience and freedom of expression as well as the rights of defendants. Application of equal protection of the laws to minority groups. Various reform proposals.

422. International Law. (3-0) Cr. 3. S. Prerequisite: 215 or 217 or 251; junior classification. Development of the principles of international law of peace and war; analysis of theories concerning its nature and fundamental conceptions, its relation to national law; problems of international legislation and codification.

430. Development of Political Thought: Ancient and Medieval. (3-0) Cr. 3. F. Prerequisite: Six credits in political science or in European history. Shakeshaft. Major political writings from Plato to Bodin. Primary emphasis on the study of translation of original works. An analysis of the ideas contained therein and of the relationships between the theories and their historical context.

431. Development of Political Thought: 16th-18th Centuries. (3-0) Cr. 3. W. Prerequisite: Six credits in political science or in European history. Shakeshaft. Major political philosophers from Bodin to Bentham.

432. Development of Political Thought: 19th-20th Centuries. (3-0) Cr. 3. S. Prerequisite: 430 or 451. Shakeshaft. Major political philosophers and schools of thought, beginning with Marx and J.S. Mill.

433. American Political Thought. (3-0) Cr. 3. S. Prerequisite: Six credits in political science or in American history. Talbot. Analysis of major trends in the development of American political ideas, institutions, and theories.

434. Political Socialization. (3-0) Cr. 3. S. Prerequisite: Six credits in political science. Shakeshaft. Theories of civic education; political learning throughout life; political attitudes, cognitions, and values of preadults; agents of political socialization; the socialization process; systemic effects of political socialization.


441. Governments of Western Europe. (3-0) Cr. 3. W. Prerequisite: 241. Dorfman. Comparative study of governments of France and Germany. Their governmental processes, political parties, electoral systems, and political problems. Comparison with the United States.

442A. Governments of China and Japan. (3-0) Cr. 3. W. Prerequisite: 241 or 3 credits from D or 207, 206, 209, or 241. Teters. Political traditions and political cultures, contemporary governmental structures and processes.

442B. Governments of India, Pakistan, and Southeast Asia. (3-0) Cr. 3. S. Prerequisite: 241. Teters. Political traditions and political cultures, contemporary governmental structures and processes.

443A. Latin American Governments. (3-0) Cr. 3. W. Prerequisite: 241 or 6 credits in Latin American history. Schmidt. Political institutions and processes in the Latin American nations.

443B. Recent Latin American Politics. (3-0) Cr. 3. S. Prerequisite: 241 or 6 credits in Latin American history. Schmidt. Analysis of selected, current political problems in Latin America.

445. Politics of the Middle East. (3-0) Cr. 3. Alt. S., offered 1975. Prerequisite: 241 or 340. Governments of the Middle East. Special attention to impact of social and technological change on the political process.

446A. 446B. Governments of Africa: South of the Sahara. (3-0) Cr. 3 each. W.S. Prerequisite: 241 or 3 credits from D St 204, 205, 206. Olumosola. Politics and governments of selected African states and territories south of the Sahara. 446A: West Africa. 446B: East Africa.

451. Asia in World Affairs. (3-0) Cr. 3. S. Prerequisite: 251 or D St 209. Tetern. Analysis of factors shaping objectives and policies of major Asian countries as participants in world politics.

452. Comparative Foreign Policies. (3-0) Cr. 3. W. Prerequisite: 251. Newcomer. Foreign policies of selected nations other than the U.S. and U.S.S.R.

453. International Organizations. (3-0) Cr. 3. S. Prerequisite: 320 or 420. Boles. Role of the United Nations and of regional organizations in the international system.

458. United States Foreign Policy. (3-0) Cr. 3. W. Prerequisite: 215 or 217; 251 recommended. Newcomer. Elements of U.S. foreign policy, foreign policy-making processes, governmental and nongovernmental agencies and forces operating on the formation of foreign policy, trends and issues, national purposes, diplomacy, and impact of the Cold War.

464. American Political Parties. (3-0) Cr. 3. F. Prerequisite: Six credits in American government. Wiggina. Systems theory applied to political parties, concepts of group structure, party evolution, party supporters and leaders, voting behavior, party in government.

468. Public Opinion and Public Policy. (3-0) Cr. 3. S. Prerequisite: Six credits in American government. Hagedoer. Role of public opinion in American politics, dimensions and agencies of opinion formation, structure and distribution of opinion, opinion sampling of selected policy alternatives.

471. Public Administration. (3-0) Cr. 3. F. Prerequisite: Six credits in American government. Wessel. Analysis of the operations of the executive branch of government. Problems of organizing that branch to achieve maximum efficiency.

472. Government and Regulation. (3-0) Cr. 3. S. Prerequisite: Six credits in American government. Wessel. Structure and politics of regulatory agencies. Interactions of the executive, congress, judiciary, and regulatory agencies.

473. Politics of Food and Fiber Policies. (3-0) Cr. 3. W. Prerequisite: Six credits in American government. Hagedoer. Policy processes in U.S. agriculture include food and fiber policies: exports—commercial and concessional, imports, health and nutrition, welfare and education, research, price, and income.

474. Government and Conservation Policies. (3-0) Cr. 3. W. Prerequisite: Six credits in American government. Talbot. The political process in the area of public and private land, forest, water, and recreation policies. National legislative, executive, and administrative processes as they apply to federal grant-in-aid programs. State policies.

475. Science and Government. (3-0) Cr. 3. W. Prerequisite: Six credits in American government. Talbot. The political impact on selected policy development in certain federal organizations, e.g., NASA, AEC, HEW, Commerce, and NSF.

476. Administrative Law. (3-0) Cr. 3. S. Prerequisite: 215 or 217; junior classification. Boles. Constitutional problems of delegation of governmental powers, elements of fair administrative procedures, judicial control over administrative determinations.

490. Special Problems. Cr. 1 to 6 each time taken. F.W.S.S.S. Special studies in the political institutions, processes and policies of American, foreign, and international governments. Also, studies in traditional and behavioral political theory.

A. Topical and experimental courses.
B. Independent study.
H. Honors.
I. Internship.

Extended credits. The student may earn an additional 1 or 2 credits for extra study done for any 400-level course, with instructor's approval, and, provided that so doing does not bring student's total number of credits to more than 18.

*The department recommends that credit in 217 should not be applied toward graduation if the student has received credit for 215 or 216.

+The department recommends that credit in 335 should not be applied toward graduation if the student has received credit for 330 or 331.

Courses Primarily for Graduate Students, major or minor, open to qualified undergraduates

510. Government and Politics. (3-0) Cr. 3. F. Prerequisite: 310. Wiggina. A comparative analysis of political systems. Role of interest groups, political parties, legislatures, courts, and governors in state politics. Examination of possible determinants of public policy outputs at the state level.

511. Public Policy and Local Government. (3-0) Cr. 3. W. Prerequisite: 310. Boles. Analysis of structure, administration, and legal bases of state, county, township, and special districts such as school and drainage districts. Evaluation of local governmental functions such as education, welfare, highways, including problems of taxation and finance. Effects of population shifts on future of local governments.

512. Urban Politics. (3-0) Cr. 3. W. Prerequisite: 311. Fitzpatrick. Structure and process of urban political systems, selected problems in urban politics.

520. Law and Public Policy. (3-0) Cr. 3. S. Prerequisite: 320 or 420. Boles. Role of the federal judiciary in policy-making in the United States. Jurisdictional limitations and judicial attitudes and personality in the decision-making process. Statistical analyses of judicial behavior.

530. Advanced Political Thought. (3-0) Cr. 3. S. Prerequisite: Six credits in courses numbered 430 through 433. Hutter. Major contemporary developments in the theory and methodology of the discipline; consideration of professional ethics.

532. Applied Theory and Methodology. (4-0) Cr. 4. S. Prerequisite: 531. Hutter. Application of theory and methods to individual research projects.


544. Russian Political Thought and Institutions. (3-0) Cr. 3. S. Prerequisite: 444 or 6 credits in Russian history. Moses. 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.
Courses and Programs

558. Soviet Foreign Policy. (3-0) Cr. 3. W. Prerequisite: 444 or 6 credits in International Studies and Comparative Politics, Moses. Basic factors determining the formulation and execution of Soviet foreign policy. Analysis of the process and development of Russian foreign policy since 1917, emphasizing the Stalin period of the Cold War.

559. International Relations Theory. (3-0) Cr. 3. F. Prerequisite: Six credits in International Studies, Newcomer. A review, analysis, and application of recent theoretical attempts to order systematically the field of International Relations. Special attention devoted to the concepts of power, equilibrium, communications, decision making, and systems analysis.

560. Legislative Behavior. (3-0) Cr. 3. S. Prerequisite: Six credits in American government, Wiggina. Principles, procedures, and problems of the legislative process. Structure and organization of state legislatures and the United States Congress.

561. The Chief Executive. (3-0) Cr. 3. W. Prerequisite: Nine credits in American government, Hadwiger. Legal and political forces influencing the U.S. president, governors, and other governmental executives in decision making, developing and administering programs of government, leading public opinion, and influencing legislation.

571. The Administrative Process. (3-0) Cr. 3. W. Prerequisite: 471. Wessel. An analysis of classic and current administrative theory, with applications to the budgetary process.

590. Special Topics. Cr. 2 to 5 each time taken. Prerequisite: Fifteen credits in political science, permission of instructor.
   A. American Political Institutiona
   B. Public Law.
   C. Political Theory and Methodology.
   D. Comparative Government.
   E. International Relations.
   F. Political Parties and Policy Formation.
   G. Public Administration and Public Policy.

Courses for Graduate Students, major or minor

610. Graduate Seminar. (3-0) Cr. 3 for each seminar. Prerequisite: Fifteen credits in graduate courses in political science.
   A. American Political Institutiona
   B. Public Law.
   C. Political Theory and Methodology.
   D. Comparative Government.
   E. International Relations.
   F. Policy Process.
   G. Public Administration and Public Policy.

699. Research.

Preprofessional Study

Requirements for admission to most professional academic programs can be met by study at Iowa State University. Preprofessional programs vary from one to four years. In some programs requiring three years of preprofessional work, a student may, by careful planning, complete requirements for the bachelor's degree in a period of four years.

Most law schools and schools of human medicine require either a bachelor's degree or satisfactory completion of three years leading to the bachelor's degree. A few still require only three years of preprofessional work, but students are urged to choose a degree program so that they will not be limited in their choice of professional schools.

Students are encouraged to identify their professional interests early in their college studies. As soon as this choice is made, students will be assigned to advisers who are familiar with requirements of the respective professional schools.

Specific information on these preprofessional programs will be furnished, upon request, by the dean, College of Sciences and Humanities.

Combination Preprofessional and Baccalaureate Programs

Preparation for the Study of Dentistry. The Council on Dental Education of the American Dental Association has prescribed two years of college education as a minimal requirement for admittance to a dental school. Because some dental schools have more extensive preprofessional requirements oriented toward a more liberal education, predentistry students are advised to take three years of preparatory college work, which, with the first year of dental school, may lead to receipt of the bachelor's degree from Iowa State University.

Preparation for the Study of Medical Technology, Cytotechnology and Nuclear Medical Technology. Technologists in these areas work usually under the supervision of a physician in hospital laboratories, medical clinics, industrial medical laboratories, pharmaceutical laboratories, or in conjunction with public health agencies. The minimal preprofessional requirement is three years of college study emphasizing communication skills, biology, chemistry, and electives in social sciences, arts, and humanities. Students may receive the bachelor's degree from Iowa State University by completing a program including three years of college work plus a year of professional study at any hospital school approved by the American Medical Association.

Poultry Science

For description of courses, see Animal Science.
Preparation for the Study of Physical Therapy. Physical therapists work under the direction of physicians in administering therapeutic agents such as massage and exercise, heat, baths, light, and electricity. Preprofessional education should include three academic years of study leading to strong backgrounds in the natural sciences, social sciences, and humanities. Students may receive the bachelor’s degree from Iowa State University by transferring back 45 credits from the first year in a school of physical therapy.

Preparation for the Study of Veterinary Medicine. Although most schools of veterinary medicine require two years of preprofessional college education, more students are choosing three years of college work before beginning their professional programs. This permits them to broaden their education in both the sciences and humanities, and may lead to the baccalaureate from Iowa State University upon completion of the first year of study in a school of veterinary medicine. For additional information see Veterinary Medicine, Admission Requirements.

Four-Year Preprofessional Programs

Preparation for the Study of Human Medicine. Most medical schools recommend a preprofessional background composed of a good foundation in the natural sciences (mathematics, chemistry, biology, physics), highly developed communication skills, and a rich background in the social sciences, humanities, and arts. To obtain this background, students should elect four years of preprofessional study leading to the bachelor’s degree.

Preparation for the Study of Law. Most law schools now require applicants to present a bachelor’s degree from a college or university prior to commencing the study of law. In cases where students can be admitted to an accredited law school without having obtained the bachelor’s degree, Iowa State, in certain curricula, will grant this degree following three years of study here and completion of suitable credits (usually obtainable in one year) at a law college. Programs of three-year prelaw education (with the bachelor’s degree deferred) at Iowa State University should be planned not later than the sophomore year, and must be approved by the student’s major department and by the dean of the college in which the student is enrolled.

Other Preprofessional Programs

Preparation for the Study of Dental Hygiene. The dental hygienist provides a variety of patient treatments prescribed by the dentist. The preprofessional program consists of two academic years of liberal arts after which the student transfers to an other institution which offers the professional program. Satisfactory completion of this two-year program leads to the bachelor’s degree from the professional institution.

Preparation for the Study of Marine Biology, Oceanography (Chemical, Geological, Physical), and Pharmacology. College preparatory work for each of these areas consists of a program leading to the bachelor’s degree, after which students begin technical programs of study at the graduate level, leading to advanced degrees. Iowa State University offers in preparation for each of these areas a full undergraduate program leading to the bachelor’s degree.

Preparation for the Study of Nursing. Depending upon the extent of professional nursing education desired by students, Iowa State University offers one or two years of preprofessional study in the sciences and humanities. After completion of the preparatory program, students transfer to some other institution which offers professional education in nursing. Students who plan to transfer to the State University of Iowa in the summer after completion of two years of preprofessional study must file two application forms with the State University of Iowa not later than November 15 of their sophomore year. One form, the State University of Iowa Application for Undergraduate Admission, is sent to the Admissions Office. The other, the Cooperative Transfer Program Registration Form, is sent to the Articulation Project, College of Nursing.

Preparation for the Study of Optometry. The practice of optometry, the profession specifically licensed to care for human vision, requires two years of preprofessional study followed by four years of professional study. This leads to the awarding of a professional degree by the institution offering the professional program. The preprofessional program at Iowa State University emphasizes biology, communication skills, physical sciences, social sciences, and humanities.

Psychology

Thomas W. Turnage, Head of Department


Associate Professors: Avant, Betz, Kahn, Menne, Peters.

Assistant Professors: Arnold, Borgen, Cherry, Dickinson, Dissing, Jacoby, Lando, McManus, Phye, Scott, Wijting.
Undergraduate Study

For the undergraduate curriculum in sciences and humanities, with 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. Experimental psychologists are concerned with basic research in learning, memory, perception, problem-solving, and cognition. 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 services to help improve the efficiency and personal satisfaction of workers. Psychologists also work in the public schools with pupil problems, especially those of exceptional (different from the average) children.

An undergraduate major in psychology may be taken as general education, in preparation to teach psychology in the secondary schools (usually in combination with another subject major area), or as preparation for graduate study. Holders of the baccalaureate work in a wide variety of settings. Professional work in psychology requires graduate degrees.

A program of study will be developed in consultation with the major adviser which meets the needs and interests of the student and the department.

The psychology requirement for an Iowa professional teaching certificate will be met by 230 and 333. For teacher certification requirements see College of Education, Curriculum.

Undergraduate majors in psychology are encouraged, but not required, to take a foreign language.

Graduate Study

The department offers work for the degrees Master of Science and Doctor of Philosophy with major in psychology, and minor work to students taking major work in other departments. A two-year Master of Science interdisciplinary program is offered in school psychology.

Students desiring a graduate major in psychology must have been graduated from an accredited college in a curriculum substantially equivalent to the undergraduate curriculum in Sciences and Humanities at Iowa State University. Prerequisite to admission is at least 15 credits of basic psychology, which should include a laboratory course and a measurement-statistics course.

The department also participates in the interdepartmental program of industrial relations (see Industrial Relations).

Foreign language is not required for the advanced degrees offered by this department.

Open to graduate students for minor credit only 401, 430, 436, 437, 440, 450, 451, 460, 495.

Courses Primarily for Undergraduate Students


101. General Psychology. (3-0) Cr. 3. F.W.S.S. Introduction to fundamental psychological concepts derived from the application of scientific method to the study of behavior. Applications of psychology. Recommended for freshmen and sophomores only.

202. Sensation and Perception. (4-0) Cr. 4. F.W.S.S. Appraisal of traditional and contemporary psychophysical models. General characteristics of the senses; conditions and principles of human perception with emphasis on vision.

206. Learning and Motivation. (4-0) Cr. 4. F.W.S.S. Fundamental concepts and principles of learning and motivation. Consideration of data from human and animal experimentation.

230. Developmental Psychology. (Educ 230) (4-0) Cr. 4. F.W.S.S. Characteristic development and decline of physical traits, learning and intelligence, social and emotional behavior, personality and adjustment from conception to senescence. Emphasis on childhood and adolescence. 230H: Honors section. Emphasis on original research literature and individual projects. For students in University Honors Program only.

250. Consumer Psychology. (3-0) Cr. 3. F.W.S.S. Prerequisite: 101. Application of psychological principles in marketing to include selling, advertising, packaging, and sales promotion; introduction to consumer surveys and motivational research techniques.

301. Research Design and Methodology. (3-0) Cr. 3. F.W.S.S. Prerequisite: 202 or 206, Stat 101. Research methodology in psychology. Emphasis on rationale underlying procedures for control and manipulation of experimental variables. Designs appropriate for various research questions and of procedures for data reduction and evaluation.

302. Experimental Psychology Laboratory. (0-6) Cr. 3. W.S. Prerequisite: 301. Laboratory experience in designing and executing research in various areas of experimental psychology. Emphasis on designing experiments, setting up laboratory equipment, collecting and evaluating data, and preparing research reports.


305. Physiological Psychology. (3-0) Cr. 3. 3. Prerequisite: 206. Neurophysiological correlates and systems underlying behavior. Physiological processes underlying sensorimotor activity, motivation, and learning.

383. Educational Psychology. (Educ 383) (3-2) Cr. 5. F.W.S.S. Prerequisite: 230. Human learning, with particular reference to applications in educational settings; intellectual, personal, and social influences on the learning process; measurement and evaluation of educational outcomes.

345. Individual Differences. (3-0) Cr. 3. F.W.S.S. Prerequisite: One course in psychology. Individual differences in psychological characteristics and behaviors. Factors producing and effecting these differences. Differences among groups; sex, race, class.

380. Social Psychology: Psychological Perspectives. (5-0) Cr. 5. F.W.S.S. Prerequisite: Two courses in psychology, including 206 or 333. Individual human behavior in social contexts. Emphasis on attitudes, perception of others, social influence, attraction, aggression and small group behavior, such as conformity, power, leadership, status, norms.
385. Psycholinguistics. (3-0) Cr. 3. S. Prerequisite: Two courses in psychology. Psychology of language and language processes: theory and findings in speech perception, cognition, memory for linguistic stimuli, and development of linguistic processes.

401. History and Systems in Psychology. (3-0) Cr. 3. F. Prerequisite: Three courses in psychology. Philosophical and theoretical antecedents of contemporary psychology.

430. Psychology of Adolescence. (3-0) Cr. 3. F. W.S.S. Prerequisite: Two courses in psychology, including 230; or one course in psychology and both C D 225 and 226; junior classification. Developmental characteristics of the adolescent: examination of antecedents of behavior with a goal of better understanding of this age group; implications for education and guidance.

436. Psychology of the Exceptional Individual. (4-0) Cr. 4. F. W.S.S. Prerequisite: Two courses in psychology, including 230; or one course in psychology and both C D 225 and 226; junior classification. Behavioral characteristics, problems, and needs of a wide variety of atypical persons, including the gifted.

437. Psychology of Exceptional Children; Research and Practicum. (1-4) Cr. 3. F. S. Prerequisite: 436, permission of instructor. Field work with exceptional children in an educational, institutional, or day-care setting. Research and independent study in a selected aspect of exceptionality. Preparation of research and case reports, or only case report.

440. Psychological Measurement I. (3-0) Cr. 3. F. W.S.S. Prerequisite: Two courses in psychology, Stat 101. Principles of psychological measurement including sources of test information, quantitative concepts with applications to test construction, factors influencing test performance, uses and misuses of tests in counseling, educational, and industrial settings.

450. Industrial Psychology. (3-0) Cr. 3. F. W.S.S. Prerequisite: Two courses in psychology or junior classification. Content and methods of industrial psychology. Selection models and techniques. Performance appraisal, attitudes, motivation, training, decision-making.

451. Organizational Psychology. (3-0) Cr. 3. W. S. Prerequisite: Two courses in psychology or junior classification. Content and methods of organizational psychology. Emphasis on organizational theory, structure of organizations, organizational change, conflict resolution, group performance and morale, communication.

460. Personality and Psychopathology. (5-0) Cr. 5. F. W. S.S. Prerequisite: Two courses in psychology, including 206 or 333. Major approaches to the study of personality. Normal and abnormal modes of adjustment. Emphasis on motivation and learning in the development of personality and adjustment patterns.

490. Special Problems. Cr. var. F. W.S.S. Prerequisite: Two courses in psychology; permission of instructor before registration. Guided reading on special topics, or individual research projects.

Courses Primarily for Graduate Students, major or minor, open to qualified undergraduates


522. Psychology of Counseling. (3-0) Cr. 3. F. W.S.S. Prerequisite: Four courses in psychology, including 440. Survey of theories, techniques, and tools of counseling. Emphasis on their psychological foundations and relevant research.

523. Vocational Psychology. (2-2) Cr. 3. W. Prerequisite: Three courses in psychology. Theories of vocational behavior, including vocational choice, and their relationship to job satisfaction and job performance. Developmental aspects and occupational classification systems.

530. Advanced Developmental Psychology. (3-0) Cr. 3. S.S.S. Prerequisite: Four courses in psychology, including 230, or C D 225. Critical evaluation of major research in physical, sensory, intellectual, emotional, and social development. Human behavior from conception to senescence. Maturity and age emphasized.

533. Advanced Educational Psychology. (3-0) Cr. 3. F. S.S. Prerequisite: Three courses in psychology, including 333. Theories of learning, motivation, and cognitive development applicable to classroom settings. Consideration of education as a behavioral science.
Courses for Graduate Students, major or minor

601, 602, 603. Historical and Systematic Psychology. (2-0) Cr. 2 each Yr. Prerequisite: 601: Second year graduate standing; 602: 601; 603: 602, 601: Origins of psychology in classical, medieval, and Renaissance thought. Development of psychology as a science in nineteenth and twentieth centuries. Historical roots of contemporary problems. 602: Philosophical and methodological problems of psychology. Traditional and contemporary procedures and strategies in the study of psychology. 603: Traditional and contemporary theoretical approaches to learning, sensation-perception, personality, development, and abnormal psychology.

604. Cognition. (3-0) Cr. 3. F. Prerequisite: 504. Advanced experimental investigation and theory of cognitive processes including thinking, problem-solving, and conceptual behavior.

605. Psychology of Motivation. (2-0) Cr. 2. W. Prerequisite: 503 or 504. Major research findings and theoretical concepts in the psychology of motivation.

620. Counseling Process and Dynamics. (3-2) Cr. 4. F.W.S. Prerequisite: 522. Advanced theory and practice in psychological counseling with emphasis on applications of counseling and testing techniques. Case studies and role playing.

631. Seminar in Exceptional Intelligence. (2-0) Cr. 2 each time taken, maximum of 10 credits. F. Prerequisite: 508 or 509. Psychological characteristics of the mentally deficient, gifted, and creative. Theoretical views, current research in learning and cognition, perception, language, motor skills, adjustment. Implications for clinical and educational practice.

633. Teaching of Psychology. (3-0) Cr. 3. W.S. Prerequisite: Enrollment in Ph.D. or terminal M.S. program in psychology, completion of at least one year graduate study, permission of instructor. Orientation to teaching of psychology at college level: academic issues and problems, instructional and evaluative techniques.

691. Practicum in Psychology. Cr. var. Prerequisite: Permission of instructor. Supervised practice and experience in the following fields of specialization in applied psychology.

A. Counseling.
B. Industrial.
C. School Psychology.
D. Individual Testing.
E. Teaching.

692. Seminar in Psychology. (1-0 to 3-0) Cr. 1 to 3 each time taken. Offered when demand warrants.

A. Counseling.
B. Educational-Developmental.
C. General-Experimental.
D. Industrial-Organizational.
E. Psychometrics.
F. School Psychology.
G. Social.

699. Research.
Sociology and Anthropology

George M. Beal, Chairman of Department


Associate Professors: Chang, Cohen, Ed Powers, Yoesting.

Assistant Professors: Braito, Bruton, Goudy, Hraba, Johnson, Keith, Miller, Richards, Rogers, Schafer, Specht, Tait, Whiteford, Wilcox, Yep.

Instructors: Deskin, Ringle, Michael Warren.

Visiting Lecturers: Lee, Nagel.

Undergraduate Study

The department offers work for the degrees Bachelor of Arts and Bachelor of Science with majors in sociology and anthropology, and work for the degree Bachelor of Science in public service and administration in agriculture. Programs of study offered in both the College of Agriculture and the College of Sciences and Humanities are outlined in this section. For the undergraduate curriculum in sciences and humanities, with majors in sociology and anthropology, leading to the degrees of Bachelor of Arts and Bachelor of Science, see Sciences and Humanities, Curriculum. For the undergraduate curriculum in agriculture, with major in public service and administration in agriculture, leading to the degree Bachelor of Science, see Agriculture, Curriculum in Public Service and Administration in Agriculture.

College of Sciences and Humanities—Sociology

A major in sociology can serve as a liberal arts education; as preparation for various positions in social service and related occupations; as background for professional education in such areas as social work, law, and theology; or as a basis for graduate professional training as a sociologist in academic, government, business, and industrial settings.

A program of study which meets the needs and interests of the student will be developed in consultation with the major adviser. Programs of study will include 134, 201, 302, 305, and 310. Programs leading to a Bachelor of Arts degree will emphasize additional course work in groups I and II of the general education requirements. Programs leading to a Bachelor of Science degree will emphasize additional course work in Group III of the general education requirements. Programs for both degrees will place emphasis on additional course work in group IV of the general education requirements. Some of the possible fields of concentration are family sociology, leisure and environmental resources, criminal justice system, industrial sociology, research methods and statistics, community (urban and rural sociology), social change and sociology of development, social welfare, complex organization, human population and ecology, and sociological theory.

College of Sciences and Humanities—Anthropology

An undergraduate major in anthropology can serve as the nucleus for a general liberal education, or as the prerequisite for graduate training qualifying a person for positions in (1) college and university teaching, (2) research, and (3) administrative and applied positions in government and museums. Fields of anthropology are cultural anthropology (ethnology, social anthropology, archaeology, psychological anthropology, and anthropological linguistics), and physical anthropology (man’s biological evolution, constitution, and modern variations). Undergraduate students may obtain experience in archaeological and ethnological research. Anthropology majors may elect either a Bachelor of Arts or a Bachelor of Science degree. A Bachelor of Arts degree is obtained by fulfilling the college general education requirements plus 10 additional credits in Group I and/or Group IV. A Bachelor of Science degree is obtained by fulfilling the college general education requirements plus 10 additional credits in Group III.

Undergraduate students with majors in anthropology usually include the following courses in their programs: 111, 218, 219, 220, and 221. Excellent supporting courses directly related to anthropology will be found in sociology, psychology, zoology, genetics, history, political science, philosophy, earth science, and economics. Undergraduates majoring in anthropology may elect these areas or others as minors. Anthropology majors may elect a second major in International Studies. Undergraduates majoring in sociology, and majors outside the department may minor in anthropology.

The principal subdisciplines of anthropology are represented by the following:

3. Psychological Anthropology: 422.
5. Physical Anthropology: 219, 490C.

College of Agriculture—Public Service and Administration in Agriculture

The curriculum in public service and administration in agriculture is designed for students who desire an interdisciplinary education to pursue a career with agriculturally related governmental and
private agencies, or with businesses and industries which are concerned with public services in agriculture. Students will explore the planning and implementing of agriculturally related programs in communities (town, city, or county), multi-county areas, states, regions, and at the federal level. The curriculum has a broad base of general education subjects including credits in communications, mathematics, physical and biological sciences, and the social sciences and humanities. The technical subjects represent a combination of sociology, economics, government, and technical agriculture, with emphases in social and economic change, history of public services, complex organizations, inter-agency relationships, community leadership, community action, adoption and diffusion, group dynamics, land utilization, and political and legal behavior as they relate to agriculture.

Graduate Study

The department offers work for the degrees Master of Science and Doctor of Philosophy with majors in sociology and rural sociology and minor work for students majoring in other departments. Within the major of sociology, students may specialize in family, complex organization, population, research methods, community, social change, theory, and leisure and environmental resources. Within the sociology major students may specialize in anthropology at the Master's level.

The department stipulates no language requirement for either the degree Master of Science or the degree Doctor of Philosophy. However, it may be relevant in individual cases to specify competence in one or more languages.

The department is a cooperating department in the industrial relations program. (See Industrial Relations.)

Courses open to graduate students for minor credit only:


Courses Primarily for Undergraduate Students

Courses in Sociology

*110. Orientation to Public Service and Administration in Agriculture. (1-0) Cr. F. R. Survey of public service and administration in agriculture.

*130. Rural Institutions and Organizations. (4-0) Cr. 4. F.W.S.S. Analysis of basic institutions and organizations found in rural society. Emphasis on structure, functions, and social change in nonmetropolitan institutions. Effects of group relations on human behavior. The department recommends that credit in both 130 and 134 not be applied toward graduation.

134. Introduction to Sociology. (3-0 or 4-0) Cr. 3 or 4. F.W.S.S. Analysis of the effects of group relations on human behavior; interrelations of personality, group, community, and culture; major social processes; practical study of society. The department recommends that credit in both 130 and 134 not be applied toward graduation.

135. Social Problems. (4-0) Cr. 4. F.W.S.S. Prerequisite: 130 or 134. Nature and meaning of social problems; influences and characteristics of selected social problems of major public interest; analysis of proposed solutions.

201. Sociological Inquiry and Social Organization. (5-0) Cr. 5. F.W.S.S. Prerequisite: 130 or 134. A systematic examination of theory-building tools applied to the social organization of society.

219. Courtship and Marriage. (3-0) Cr. F. S. W. S.S. Prerequisite: 130 or 134. A person-centered analysis of courtship and marriage relationships; contributions of the various fields of knowledge to the understanding of courtship and marital adjustment.

227. Sex Roles in Modern Society. (3-0) Cr. 3. W. Prerequisite: 130 or 134. Examination of changes in sex role learning, feminity-masculinity, sex role conflicts, and sociocultural value patterns.

264. Group Dynamics. (2-3) Cr. 3. F.W.S.S. Prerequisite: 130 or 134. Planning and conducting group activities; relation of group dynamics and group techniques to group productivity; laboratory, group analysis, field practices.

300. Race and Minority Group Relations. (4-0) Cr. 4. F.W.S.S. Prerequisite: 130 or 134. Minority groups and social structure; analysis of causes and consequences of group conflict with emphasis upon prejudice and discrimination in the United States.

302. Research Methods in Sociology. (4-0) Cr. 4. F.W.S.S. Prerequisite: 201. Research design, field procedures and analysis of data.

304. Introduction to Social Ecology and Population Studies. (3-0) Cr. 3. F.W.S.S. Prerequisite: 130 or 134. Concepts of social ecology; population problems; size, composition, and distribution of population change.

305. Social Psychology: A Sociological Perspective. (4-0). Cr. 4. F.W.S.S. Prerequisite: 130 or 134. Examination of social behavior with emphasis on development of self, attitudes and attitude change, interpersonal relations, small groups, and collective behavior.

*310. Community. (3-0) Cr. 3. F.W.S.S. Prerequisite: 130 or 134. Comparative analysis of the institutional structure of rural, urban, and suburban communities; community as an ecological and social system; power relationships.

311. Sociology of Poverty. (3-0) Cr. 3. F.S. Prerequisite: 130 or 134. Conditions of poverty; determination of poverty levels; studies of inequality, concentrating on the poor; attitudes toward poverty.

322. Conflict and Accommodation. (3-0) Cr. 3. F. Prerequisite: 130 or 134. Functions of social conflict, strategies and techniques of conflict and accommodation, distribution of power, societal mechanisms for conflict management and resolution.

340. Sociology of Compliance and Delinquency. (3-0) Cr. 3. F.W.S. Prerequisite: 130 or 134. Analysis of society's regulatory processes through socialization and social control, ways individuals develop perceptions toward a criminal justice system, facilitation of this process by societal reactions.

341. Sociology of Deviance and Criminology. (3-0) Cr. 3. F.W.S. Prerequisite: 130 or 134. Meaning, identification, and causes of deviance; recruitment from deviant to normal identities; role of social institutions in correction, control, and prevention of deviance.

380. Sociology of Work. (3-0) Cr. 3. F.W.S. Prerequisite: Six credits in sociology. Work, worker adjustment and alienation, characteristics of the occupational, formal and informal aspects of work organizations.

*382. Sociology of Agricultural Marketing Firms. (3-0) Cr. 3. S. Prerequisite: 130 or 134. Sociological analysis of merchandising, marketing, and management in local
400. History of Sociological Thought. (3-0) Cr. 3. W. Prerequisite: Nine credits in sociology. Origin and development of sociological thought from earliest times to 1860.

401. Contemporary Sociological Theories. (4-0) Cr. 4. S.SSIL. Prerequisite: Twelve credits in sociology. Analysis of major theories from 1860 to present.

409. Sociology of Rural Life. (4-0) Cr. 4. F. Prerequisite: Six credits in sociology. Changing characteristics of rural human relationships, values, institutions affected by changing population, technology, and agricultural practices.

410. Urban Sociology. (4-0) Cr. 4. F.W.SS.SS. Prerequisite: Six credits in sociology. Growth, structure, and functions of the city; urban-social relations.

411. Societal Change and Development. (3-0) Cr. 3. S. Prerequisite: 130 or 134. Contemporary changes in rural and urban society with analysis of social institutions, social organizations, and social values. Theories of social change. Adequacy of existing social structures to meet needs of people. Alternative development structures and strategies to meet changing needs.

415. Adoption and Diffusion of Innovations. (3-0) Cr. 3. W. Prerequisite: 130 or 134. Processes of adoption and diffusion of innovations. Factors related to differential rates of adoption of new technology, such as sources of information, attitudes, values, knowledge, and personal and social characteristics.

420. Analysis of Complex Organizations. (3-0) Cr. 3. F. Prerequisite: Six credits in sociology. Organizations as bureaucratic social systems. Emphasis on comparison of organizations and agencies and their internal operations; linkages among agencies and to the general public.

430. Social Stratification. (3-0) Cr. 3. F.W.SS.SS. Prerequisite: Six credits in sociology. Theories of social stratification and social class; caste, estate, and class stratification systems in various social structures. Analysis of studies of class in America; types and measurements of mobility.

440. Systems Analysis of Criminal and Juvenile Justice. (3-0) Cr. 3. W. Prerequisite: 340 or 341. Criminal and juvenile justice: detection, labeling and arrest, prosecution, adjudication, sentencing, imprisonment, release, reconviction.

445. Population Studies. (3-0) Cr. 3. S.SSIL. 1974, SSIL. 1975. Prerequisite: 130 or 134. Dynamics of population development with emphasis on theories of population, fertility, mortality, and migration as components of population change; techniques of measurement of demographic phenomena; projection of population trends.

450. Human Ecology. (3-0) Cr. 3. F.W., SSIL. 1974, SSIL. 1975. Prerequisite: Six credits in sociology. Development of human ecology as a discipline and its relationship to general ecology: basic concepts, theories, and methods developed by human ecologists as applied to the study of cities, community structure, social areas, and social ecological elements as determinants of man's relationship to environment; the ecosystem as a frame of reference.

455. Field Observation and Practice. Cr. var. Not more than 16 credits may be counted toward graduation. Prerequisite: Permission of instructor. Supervised practice in established organizations and agencies.

460. Observation and Practice in Criminal and Juvenile Justice. Cr. var. from 8 to 18 credits. F.W.SS.SS. Prerequisite: Permission of instructor. Study of the criminal and juvenile justice systems and social control processes. Supervised placement in a police department, prosecutor's office, court, probation and parole department, penitentiary, juvenile correctional institution, or related agency.

461. Social Welfare. (3-0) Cr. 3. F. Prerequisite: Nine credits in sociology. Policy issues, comparative institutional analysis (historical and cross-cultural), normative and organizational structure.

462. Social Work Theories and Practices. (3-0) Cr. 3. W. Prerequisite: 461. Current theories and practices in social case work, group work, and community organization.

463A, 463B. Social Work Skills and Field Placement. Cr. 5 each. 463A: W.; 463B: S. Prerequisite: 463A: Concurrent registration in 463, permission of instructor; 463B: 463A. Prerequisite: Instructor. 463A: Specific principles and methods of social work. 463B: Field placement in selected welfare agencies under professional supervision. It is strongly recommended that students who take 463A take 463B as well.

464. Community Action. (3-0) Cr. 3. F.SSIL. Prerequisite: 201. Community analysis of mobilization and organization of human and social system resources for social action programs.

471. Sociology of Education. (3-0) Cr. 3. F.SSIL. Prerequisite: 130 or 134; Educ 204 for education majors. American schools as social organizations, as community institutions, and as socialization agents.

473. Sociology of Youth. (3-0) Cr. F.W.SS.SS. Prerequisite: 130 or 134. Sociological analysis of the development of youth subcultures in society; socialization in complex society and the social implications of youth transition into adult culture.

480. Industrial Sociology. (3-0) Cr. 3. W. Prerequisite: Six credits in sociology. Implications of technological change on modern industrial organizations; social consequences of automation.

482. Social Behavior and Environmental Resources. (3-0) Cr. 3. F.SSIL. Prerequisite: 130 or 134; Biol 103 recommended. Natural resource problems, value orientations toward the environment, environmental quality and quantity as social problems, conservation as a social movement, organizational patterns in resources management.

483. Sociology of Leisure and Recreation. (3-0) Cr. 3. W.SSIL. Prerequisite: Six credits in sociology. The social significance of leisure, the human values in leisure-time pursuits, evaluation of current uses of leisure, the social institutional structure and functional systems of society related to leisure behavior.

485. Sociology of the Family. (3-0) Cr. 3. F.W.SS.SS. Prerequisite: 130 or 134. Analysis of the family as a group; cultural influences, group processes, and institutional aspects.

486. Social Power. (3-0) Cr. 3. W.SS.SS. Prerequisite: 130 or 134. Genesis of leadership, leader-follower roles and leader types in modern society, case studies of contemporary theories. A sociological analysis of community leadership. Review of findings relative to formal and informal leadership patterns in the community organizations. Implications of leadership patterns for community action.

490. Special Problems. Cr. 1 to 5 each time taken. Prerequisite: Nine credits in sociology; permission of instructor.

A. General Sociology.
B. Rural Sociology.
C. Social Problems.
D. Industrial Sociology.
E. Family Sociology.
F. Honors.
J. Senior Seminar.
K. Sociology of Small Groups.

*Administered through the College of Agriculture. Courses not marked by an asterisk are administered through the College of Sciences and Humanities.
Courses Primarily for Graduate Students, major or minor, open to qualified undergraduates

Courses in Sociology

500. Intermediate Sociological Inquiry and Theory. (4-0) Cr. 4. 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.

511. Intermediate Research Methods in Sociology. (4-0) Cr. 4. F. Prerequisite: 302. Problem selection; experimental design; construction of instruments; collection, interpretation, and reporting of data.

520. Advanced Social Psychology: A Sociological Perspective. (3-0) Cr. 3. W. Prerequisite: 500. Contemporary theories of symbolic interaction, exchange, role, and reference group; dramaturgical and ethnomethodological approaches.

521. Small Groups. (3-0) Cr. 3. Alt. S., offered 1974. Prerequisite: 305 or Psych 380. Examination of alternative theoretical models for analyzing small groups. Methodological approaches and research findings.

525. Collective Behavior and Social Movements. (3-0) Cr. 3. F. Prerequisite: 306 or Psych 380. Inquiry into the nature of individuals and societal conditions related to mass behavior such as crowds, mobs, riots, and social movements.

530. Social Organization. (3-0) Cr. 3. S. Prerequisite: 500. Contemporary theories of group structure and process. Factors affecting the structure of society; classification of basic social forms.


533. Models of Community. (3-0) Cr. 3. Alt. S., offered 1974. Prerequisite: Nine credits in sociology. Emphasis on different models or frames of reference used in community analysis. Theoretical and methodological tools, current views of community problems and explanation of social and cultural change presented for each model.

534. Inter-Organizational Relations. (3-0) Cr. 3. Alt. S., offered 1975. Prerequisite: Nine credits in sociology. Theories of inter-organizational relations; models of coordination; guidelines for establishment and maintenance of interagency cooperation.


540. Contemporary Theories of Social Change. (3-0) Cr. 3. S. Prerequisite: 500. Examination of contemporary theories of social change.

548. Sociology of Environmental Resources. (3-0) Cr. 3. Alt. SSI, offered 1975. Prerequisite: Nine credits in sociology. Environmental values and institutional patterns affecting man's use of natural resources; social factors in natural resources management; environmental quality as a social problem.

550. Principles of Population. (3-0) Cr. 3. F. Prerequisite: Graduate classification. Survey of theories and basic concepts of social demography; determinants and consequences of population change; techniques of measuring demographic phenomena; survey of current research.


575. Social Change and the Family. (3-0) Cr. 3. F. Prerequisite: 485. Analysis of the interrelationships of the family institution and social change; industrialization, urbanization, modernization, mobility. Functions of the family in a modern and changing society.

590. Special Topics. Cr. 1 to 5 each time taken. Prerequisite: Fifteen credits in sociology, senior or graduate classification.

A. General Sociology.
B. Social Problems.
C. Industrial Sociology.
D. Family Sociology.
E. Leisure and Environmental Resources.
F. Social Stratification.
G. Sociology of Religion.
H. Sociology of Education.

Courses for Graduate Students, major or minor

Courses in Sociology

*600. Advanced Theory Construction. (3-0) Cr. 3. W. Prerequisite: 500. Contemporary theory construction in sociology, concept formation, models in sociology, stages in development of sociological theory. Formal strategies to theory construction.

605. Historical Sociological Theory. (3-0) Cr. 3. S. Prerequisite: 500. Philosophical and theoretical bases of sociology. Historical antecedents of contemporary sociological theories. Comparison of various schools in sociology.

606. Sociology of Knowledge. (3-0) Cr. 3. Alt. W., offered 1974. Prerequisite: Nine credits in sociology courses carrying graduate credit. Sources and consequences of ideologies, with special reference to intellectual, cultural, and social movements.

611. Sociological Measurement. (3-0) Cr. 3. Alt. W., offered 1974. Prerequisite: 500, 511. Principles of measurement of major sociological variables. Foundations of measurement; types of sociological variables; construction of sociological measures, indices, and scales; methods of data collection.


628. Role and Reference Group Theory. (3-0) Cr. 3. Alt. S., offered 1975. Prerequisite: 520. Examination of major approaches to role and reference groups analysis.

642. Sociology of Adoption and Diffusion. (3-0) Cr. 3. Alt. F., offered 1973. Prerequisite: 520 and either 530 or 540. Sociological aspects of adoption and diffusion of new movement; types of adoption and factors related to rates and intensity of adoption and diffusion. Adoption unit characteristics related to rates of adoption.

644. Social Action and Community Change. (3-0) Cr. 3. Alt. W., offered 1975. Prerequisite: Nine credits in sociology. Comparative analysis of models and strategies for integrated social action. Primary emphasis on community, although applications considered to other area-based systems.

698. Seminars in Sociology. (3-0) Cr. 3 each.

A. Social Theory.
B. Social Organization.
C. Population.
D. Social Interaction and Communication.
E. Social Disorganization.
F. Social Change.
G. Human Ecology.
H. Research Methods.
J. Industrial Sociology.
K. Current Emphasis in Marriage and the Family.
L. Research in Marriage and the Family.
M. Current Research in Sociology.
N. Sociology of Education.
Courses Primarily for Undergraduate Students

Courses in Anthropology

111. Introduction to Anthropology. (3-0) Cr. 3. F.W.S.S.S. The study of man; scope, methods and subfields of anthropology; an integrated biocultural approach to the understanding of man through time and space.

218. Cultural Anthropology. (4-0) Cr. 4. F.S.S.S.S. Prerequisite: 111. 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.

219. Physical Anthropology. (3-2) Cr. 4. W. Prerequisite: 111. Human origins, fossil man, differentiation into races; structural and functional anthropology of the living; interplay of biological and cultural factors in human evolution.

220. Archaeology. (3-2) Cr. 4. F. Prerequisite: 111. The nature of archaeological evidence and interpretation. Origin and development of culture from Paleolithic assemblages through civilization.

221. Anthropological Linguistics. (4-0) Cr. 4. S. Prerequisite: 111. Introduction to cross-cultural study of language and communication. Application of basic linguistic techniques in anthropological study of communication, and conceptual aspects of cultural systems.

313. The Family in Cross-Cultural Perspective. (3-0) Cr. 3 & S. Prerequisite: 111. Comparative study of the functioning of household, residential, and extended kinship groups in cross-cultural perspective; operation of these groups to accomplish the function of "family" as conceptualized in our culture.

321. Comparative Studies of World Cultures. (3-0) Cr. 3. S. Prerequisite: 111. A comparative survey of cultural patterns and social institutions on a world-wide basis; representative groups within a framework of culture areas.

322. The American Indian. (3-0) Cr. 3. W.S.S.L. Prerequisite: 111. Origin and distribution of New World populations; survey of culture areas and patterns of the native peoples of North America; problems of contact and acculturation.

323. Contemporary Latin American Cultures. (3-0) Cr. 3. Alt. F., offered 1973. Prerequisite: 111. Cultural backgrounds of contemporary groups in Middle and South America; changed systems of Indian, Negro, and Mestizo groups; institutionalized values in Latin American culture.

325. Native Peoples of Middle and South America. (3-0) Cr. 3. Alt. F., offered 1974. Prerequisite: 111. Origin and distribution of native populations in Middle and South America; survey of cultural patterns of different ethnic groups; Aztec, Maya, and Inca civilizations; anthropological approaches to problems of aboriginal American culture history; European contact and acculturation.

333. Anthropological Perspectives on Black America. (3-0) Cr. 3. F. Prerequisite: 111, permission of Instructor. Race relations in the Americas; ethnohistorical approaches to their study in cross-cultural and historical perspective; contemporary ethnography of Blacks in the U.S.


400. Language and Culture. (3-0) Cr. 3. W. Prerequisite: 218. Structure and design of language; language and cognition; semantics; linguistic change; social and linguistic aspects of verbal behavior; language, world view, and cognitive style.

420. Archaeology of North America. (3-0) Cr. 3. S. Prerequisite: 220 or 322. Prehistory and early history of North America as reconstructed from archaeological evidence, peopling of the New World, major cultural historical developments north of the Rio Grande.

421. Kinship in Different Cultures. (3-0) Cr. 3. S. Prerequisite: 218 or 313. Kinship theory, comparative analysis of kinship systems, structure and functions of kinship relations in various cultures.

422. Psychological Anthropology. (3-0) Cr. 3. W.S.S. Prerequisite: 218. Psych 101. Relationship of cultural, social, and personality factors in human behavior; analysis of generational transmission of culture.

424. Ethnology of the Old World. (3-0) Cr. 3. W. Prerequisite: 218. Selected Old World cultures. One of the following will be offered each winter quarter: A. Sub-Saharan Africa. B. Europe. C. Near East. D. South and East Asia. E. Oceania.

425. Culture Change. (3-0) Cr. 3. F. Prerequisite: 218. Dynamics of culture contact and cultural evolution; acculturation; revitalization and nativist reactions.

426. Archaeology of Europe and the Near East. (3-0) Cr. 3. Alt. W., offered 1975. Prerequisite: 220. Prehistoric and early literate cultures of Europe as reconstructed from archaeological evidence, prehistoric background of Near Eastern and Mediterranean civilizations.

428. Archaeological Laboratory Methods and Techniques. (4-0) Cr. 3 & S. F.S.S.S. Prerequisite: Three credits in anthropology, permission of instructor. Laboratory processing and analysis of archaeological materials, preparation of preliminary archaeological report.

429. Archaeological Field School. Cr. 8 to 12. SS. 8 to 10 weeks. Prerequisite: Three credits in anthropology, permission of Instructor. Summer field school for training in archaeological reconnaissance and excavation techniques; documentation and interpretation of archaeological evidence.

430. Ethnological Field Methods. (3-0) Cr. 3. Alt. F., offered 1973. Prerequisite: 218, six additional credits of anthropology or sociology or combination. Concepts and strategy of anthropological field work, participant observation, theory and method in collection and analysis of ethnographic information.

490. Special Problems. Cr. 1 to 5 each time taken. Prerequisite: Nine credits in anthropology. A. Archaeology. B. Cultural Anthropology. C. Physical Anthropology. H. Honors.

Courses Primarily for Graduate Students, minor only, open to qualified undergraduates

Courses in Anthropology


510. Social Anthropology. (4-0) Cr. 4. Alt. B., offered 1975. Prerequisite: 218; 340 or 421; 322 or 424. Historical development of social anthropology; systematic survey of the structural-functionalist approach, special analysis of social structure and social organization.

520. Cultural Continuity and Change in the Prairies Prairie. (3-0) Cr. 3. Alt. B., offered 1974. Prerequisite:...
Courses and Programs

Courses for Graduate Students, minor only

Courses in Anthropology

698. Advanced Topics in Anthropology. (3-0) Cr. 3 each.
A. General Anthropology.
B. Archaeology.
C. Cultural Ecology.
D. Applied Anthropology.
E. Economic Anthropology.
F. Psychological Anthropology.
G. Political Anthropology.
H. Urban Anthropology.
I. Magico-Religious Systems.
J. Kinship Studies.

699. Research.

Soil Science
For description of courses, see Agronomy.

SPAN
Advisory Committee: Chalm er J. Roy, Ph.D., Chairman;
Arthur M. Gowan, Ph.D.; Millard R. Kratochvil,
M.A.; H. Martin Limbird, Lic. Sci. Econ.; Martin
Zober, Ph.D.

Student Project for Amity among Nations (SPAN) is a program of carefully supervised individual foreign study. Participants spend one academic year planning research projects and gaining background on the country to be visited. Field studies require at least eight weeks abroad during the summer. During the following academic year participants prepare a report on their investigation and devote appropriate effort to the promotion of SPAN.

Total credits offered are 12: 6 for preparation and the field study, 6 for the report and SPAN activity. Grades for the first 6 credits are determined by the group adviser; for the final 6 credits the grades are determined jointly by the project counselor and the group adviser. Classification may be in university studies courses or in appropriate formal or special problems courses.

Speech
William R. Underhill, Chairman of Department
Professors: Brandt, Drexler, Wilson.
Associate Professors: Connolly, Dearin, Weaver.
Assistant Professors: Gouran, Hoopes, Kaufmann,
Kraemer, Langford, Lohr, Martin, Millsapps, Myers,
Phene ger, Vallier, Waggoner.
Instructors: Charles, Cox, Culver, Davenport,
Eichmeier, Guydon, Hovland, Lemon, Perkins, Stone,
Thorson.

Undergraduate Study
The department offers introductory courses designed for all students as part of their general education, as a complement to professional training, or as an introduction to further study in the field.

A student electing to major in speech may submit, in consultation with his or her adviser, a program for either the Bachelor of Arts or the Bachelor of Science degree. This program of courses may emphasize any one of the following options: theatre and dramatic arts, interpersonal and rhetorical communication, telecommunicative arts, or speech correction. A student in dramatic arts and theatre or in telecommunicative arts normally will pursue a Bachelor of Arts degree. A student in interpersonal and rhetorical communication or in speech correction normally will pursue a Bachelor of Science degree.

Basic instruction in the department is designed to establish proficiency in oral communication necessary for successful college work and requisite to the demands of personal, professional, and civic life. In order to attain an undergraduate major in the Department of Speech a student must present a minimum of 30 credits selected from 300-level or above speech courses. A student majoring in the
department must complete a minimum of eleven
hours of writing courses, including English 104 and
105. Students majoring in the Department are limited
to a maximum of 12 credits from Special Topics
in Speech, 490A, 490B, 490C, 490D, and 490E.

Major study in speech can prepare the student
for a wide variety of later employment opportunities
depending upon his or her interests, background,
and abilities. Students can prepare to teach speech
and dramatic arts in the secondary schools (these
students will need to see the university statement of
requirements for teacher certification, and the required
courses in education listed in the catalog under the
College of Education). Students can prepare for pro-
fessional work in theatre, radio, television, film,
and in such related fields as sales, public relations,
and publicity. Programs in speech can prepare stu-
dents for graduate study in the various areas of
speech at advanced college or university levels. An
undergraduate speech major may be used as a back-
ground for premedical, prelegal, or pretheological
studies as well as for advanced study in speech
pathology. Moreover, students may select speech
as a major in pursuit of a liberal arts education.

Students majoring in other departments or colleges
may elect speech as one of their minor areas.

The Department offers a speech and hearing clinic
for students with individual speech or hearing
problems. The certified speech correctionists are
departmental faculty members with special training
and qualifications in speech and hearing therapy.

Students who major or minor in speech are
couraged to participate in the extracurricular activ-
ities sponsored by the department. These activities
include the Iowa State Debaters, Iowa State Theatre,
and Radio Workshop. Students with primary interest
in speech also are frequently invited to act in the-
atre production and in student-directed telecommu-
nicative arts programs.

Graduate Study

The department offers courses for graduate minor
credit in speech as well as supporting work for
other fields.

Courses open to graduate students for minor
credit only are: 237, 239, 375, 378, 385, 431, 432,
465, 466, 476, 478, 479.

Courses Primarily for Undergraduate Students

106. The Performing Arts. (3-0) Cr. 3. F.W.S. Theatrical
theory and practice and its influence on other performing
arts.

207. Voice and Diction. (3-0) Cr. 3. F.W.S.SSL Development
of effective speech habits: voice quality, articulation,
pronunciation. Individual improvement programs.

208. Phonetics. (3-0) Cr. 3. F.W.S. American speech
sounds and the International Phonetic Alphabet, exercises
in diction and phonetic transcription.

211. Fundamentals of Speech. (3-0) Cr. 3. F.W.S.SSL
Prerequisite: Engl 105 or 132. Principles of public speak-
ing, audience analysis, interest and attention, selection
and organization of speech material, delivery. Practice
in preparation and delivery of extemporaneous speeches.

215. Parliamentary Procedure. (1-3) Cr. 2. F.W.S. Prin-
ciples and forms of parliamentary action governing conduct
of meetings. Practice in procedures for small groups as
well as for larger deliberative assemblies.

223. Intercollegiate Debate and Forensics. Cr. 1 to
3 each time taken, maximum of 6 credits. F.W.S. Participa-
tion in intramural or intercollegiate debate and other
forensic events.

230. Telecommunication Arts Seminar. (1-0) Cr. R
F.W.S. Orientation to mass media of television, radio,
and film; guest lecturers from fields of educational
programming and viewing and discussion of selected
videotaped television programs; information about
educational films.

233, 234, 235. Television Workshop. (0-4) Cr. 2 each
F.W.S.SSL Prerequisites: 234: 233; 235: 234, 233: Duties
of the television director and the production team; labora-
ory practice in use of studios and television production
equipment. 234: Intermediate television production
involving studies of Exhibit Hall and WOI-TV. 235: Extensive
laboratory experience in television direction, audio and
camera operation, utilizing speaking and performance
projects.

237, 238. Development of the Motion Picture. (2-2) Cr
3 each. 237: F.; 238: W. Prerequisite: Engl 105 or 132.
237: Early development of motion pictures; individuals
responsible for major advances in theory and techniques.
238: Recent developments and social trends in motion
pictures.

239. Contemporary Film. (2-2) Cr. 3. S. Prerequisite:
Sophomore classification. Study of films and filmic tech-
niques, including shooting and editing of films; recording
of sound and sound from, recording contemporary
commercial films, experimental films, and innovative tele-
vision commercials and public service announcements;
collating theory and concepts of contemporary films and
film makers.

241. Radio Workshop. Cr. 1 to 3 each time taken,
maximum of 6 credits. F.W.S. Prerequisite: Engl 105 or 132,
permission of instructor. Introduction to radio techniques
in announcing, directing, acting, use of sound and music:
Practice in integrating the various audio elements in the
actual production of radio programs.

250. Theatre Practice. Cr. 1 to 3 each time taken,
maximum of 6 credits. F.W.S.SSL Prerequisite: Permission
of instructor. Practice in acting, directing, costuming, make-
up, scene construction, painting, or scene design.

251. Beginning Acting. (3-0) Cr. 3. F.W.S. Theory and
practice in fundamentals of acting including focus, recall,
imagination, and characterization, with emphasis on pan-
tomime and improvisation.

255. Fundamentals of Modern Theatre Practices. (3-2)
Cr. 4. F.W.S. Prerequisite: 106. Theories and techniques
of acting, voice, diction, stage business, stage lighting,
stage costumes, design and stage makeup; integrated
production procedures; experience in University
Theatre.

305. General Semantics. (3-0) Cr. 3. F.W.S.SSSL Prer-
quiste: Engl 105 or 132. Nature of symbolic processes;
influence of verbal habits in human affairs; relationships
between language and personal or social problems; accuracy
in the use of verbal symbols.

309. Oral Interpretation. (3-0) Cr. 3. F.W.S. Principles of
oral interpretation; practice in analysis and reading
aloud of literary selections.

312. Business and Professional Speaking. (3-0) Cr
F.W.S. Prerequisite: 211. Fundamental principles in oral
communication for common types of professional speeches;
appropriate use of video recorder for diagnostic analysis
of delivery.

313. Speech for the Classroom Teacher. (3-0) Cr
F.S. Prerequisite: 211. Oral communication in the teaching
profession; training in classroom-oriented communication activities; extensive use of video recorder for analysis of presentation.

317. Group Discussion. (3-0) Cr. 3. F.W.S. Prerequisite: 211. Practice and procedures of problem-solving groups; communication theories related to group procedures and participation.

318. Leadership in Group Discussion. (3-0) Cr. 3. S. Prerequisite: 211. Theories of group leadership in the specialized forms of group discussion, symposium, role-playing, forums.


320. Argumentation. (3-0) Cr. 3. F.S. Practice in preparing and presenting argumentative speeches; emphasis on ethical and logical duties of the advocate; analysis, evidence, reasoning, attack, and defense.

323. Debate. (3-0) Cr. 3. W. Debate fundamentals: emphasis on research, case construction, and judging; practice in various debate forms.

327. Persuasion. (3-0) Cr. 3. F.W.S. Prerequisite: 211. Examination of behavioral research in persuasion; scientific methods of evaluating persuasive communication; emphasis on application of experimental research.

329. Persuasive Speaking. (3-0) Cr. 3. S. Prerequisite: 227. Audience analysis, attention, perception, suggestion, logical and emotional proof; ethics of a persuasive speaker; use of videotape for analysis.

331. Television and Radio Broadcasting. (3-0) Cr. 3. W. Prerequisite: Engl 105 or 132. The American structure of radio-television and related industries; analysis of types of programs; role of broadcast media in education, entertainment, and public service; standards of evaluation.

332. Television and Radio Speech. (3-0) Cr. 3. F.W.S. Prerequisite: Engl 105 or 132. Theory and practice of effective television and radio speaking under closed circuit conditions.

337. Television Performance. (1-4) Cr. 3. W.S. Prerequisite: 207. Problems of the television performer; adaptations in composition and interpretation which the medium requires of performers, narrator, master of ceremonies, or actor. Studio situations designed to aid students in improving performance skills.


356. Costuming for Stage, Television, and Film. (3-0) Cr. 3. F.S. Prerequisite: 255. Costumes design and construction; techniques of costuming; use of color and materials in theatre, television, and film costumes.

357. Art of Stage Makeup. (1-4) Cr. 3. W. Basic techniques, procedures, theories, and purposes of stage makeup; special attention to application of makeup conforming to character, juvenile, and stylized roles.

360. St. Scriift. (2-2) Cr. 3. F.W. Prerequisite: 255. Technical drawings for constructing scenery; tools, materials, and techniques in constructing and painting scenery.

362. Creative Dramatics. (3-0) Cr. 3. W.S. Prerequisite: Junior standing, permission of instructor. Improvisation and playmaking with children and adults in the school, home, and community; emphasis on the elementary and preschool child.

364. Lighting and Sound. (2-2) Cr. 3. S. Prerequisite: 260. Roles of lighting and sound in determining dramatic environment; use of lighting and sound to create total artistic effect.

369. Summer Theatre Practicum. Cr. 1 to 6 each time taken, maximum of 12 credits. Prerequisite: Permission of instructor. Practicum in summer stock or repertory theatre involving production, rehearsal, and performance with opportunities for specialization in various areas.
Courses Primarily for Graduate Students, minor only, open to qualified undergraduates

504. Seminar. (3-0) Cr. 4 each time taken, maximum of 8 credits. F.W.S.SSI. Prerequisite: Twelve credits in speech courses; permission of instructor. Topics may include rhetorical and communication theory, current problems in telecommunications, or theatre problems faced by advanced students. Each time offered the seminar will be in one of the following areas.
A. Speech Communication.
B. Broadcasting.
C. Theatre.
D. Speech Education.

510. Classical Rhetoric. (4-0) Cr. 4 W. Prerequisite: 412. Greek and Roman tradition in rhetorical theory, practice, criticism, and pedagogy.

516. American Public Address. (3-0) Cr. 3. W. Prerequisite: Twelve credits in speech courses, including 412. Relations between speakers, speeches, and political or historical events.

532. Radio Programming: Production. (2-2) Cr. 3, maximum of 6 credits. S. Prerequisite: Graduate classification, permission of instructor. Creating, writing, and directing of a sample 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.

533. Television Production and Direction. (2-2) Cr. 3, maximum of 9 credits. F.W.S.SSI. Prerequisite: 235 and 332, or 432 and graduate classification. Students who have previously emphasized writing, lighting, staging, newscasting, demonstration, and involving will work as crews to create, write, direct, and produce programs for weekly broadcasts on WOI-TV.

534. Film Production and Direction. (3-0) Cr. 3. S. Prerequisite: 533 or JI 319. Survey of the film production process, including writing, continuity, direction, lighting, cinematography, composition, sound, editing, special effects, laboratory operations, and production management. Factors involved in integration of filmic form and content.

535. Film Practicum. (2-2) Cr. 3 each time taken, maximum of 9 credits. F.W.S.SSI. Prerequisite: 534. Application of the principles and theory of 534 and prior courses to exercises in direction, cinematography, sound, lighting, special effects, continuity, editing, and management. Development of technical skills involved in film production and direction.

556. Directing the Educational Theatre Program. (3-0) Cr. 3. SSSI. Prerequisite: Graduate standing, permission of instructor. Problems in directing educational theatre, play selection and new dramatic literature, theatre management, directing college and high school drama programs, conducting high school drama contests and festivals.

583. Theory and Criticism of Dramatic Production. (3-0) Cr. 3. SSSI. Prerequisite: Nine credits in courses in theatre or dramatic literature. Study of plays suitable for production by school and community groups. Examination of critical theories of play production from Aristotle to modern critics.

590. Special Topics. Cr. 2 to 6 each time taken, maximum of 16 credits. Prerequisite: Permission of department chairman.
A. Rhetoric and Public Address.
B. Speech Correction.
C. Theatre.
D. Speech Education.
E. Radio, Television, and Film.

Courses for Graduate Students, major or minor

699. Research.

Statistics
Herbert A. David, Head of Department


Associate Professors: Arnold, Groeneveld, Han, Hickman, Hinz, Isaacson, Mosier, Meeden.

Assistant Professors: Baker, Heiberger, Kennedy, Mensing, Sposato, S. Sukhatme.

Instructors: B. Bowerman, Meeker, O'Connell, Schmid.

Undergraduate Study

For the undergraduate curriculum in sciences and humanities, major in statistics, leading to the degree Bachelor of Science, see Sciences and Humanities, Curriculum. For the undergraduate curriculum in biometry see Agriculture, 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 persons, machines, and processes under operational conditions; market, sales, advertising, and consumer research; cost and price analyses; newspaper, magazine, radio, and television research; psychological testing; public health studies. Also, there are opportunities for work in statistics that require a major in a subject-matter field and a minor in statistics.

Undergraduate majors in this department usually include the following basic courses in their programs: 101, 341, 342, 343, 390, 401, 402, 411, 421, 482. A minor is ordinarily taken in mathematics. It is also advisable to have a strong minor in a field of application. These courses are not to be regarded as statements of fixed requirements or as a complete outline of the work necessary for the major. They are given solely for the convenience of students or advisers who wish to estimate the amount of basic, nonspecialized study which may be needed.

The curriculum in biometry is intended for those students who desire to apply mathematics and statistics to problems related to agriculture. The curriculum prepares the student to work with research scientists in agriculture, or for graduate study in related fields.

Students intending to do graduate work in statistics normally would take additional courses in mathematics.
Graduate Study

The department offers work for the degrees Master of Science and Doctor of Philosophy with major in statistics, and minor work for students majoring in other departments. Within the statistics major the student may specialize in experimental design, general methods, general theory, probability, statistical computing, survey sampling, or one of the many areas of applications (e.g., biometrics, econometrics, psychometrics, sociometrics, etc.). A specialization in operations research is co-offered with the Department of Industrial Engineering. The Doctor of Philosophy degree is offered jointly with other departments. Among those with which this degree has been offered are Agricultural Engineering, Agronomy, Animal Science, Economics, Forestry, Industrial Engineering, and Mathematics.

Prerequisite to major graduate work is the completion of an undergraduate curriculum essentially equivalent to the curriculum in Sciences and Humanities at this institution, together with a year of calculus and a knowledge of statistical theory and methods as contained in Stat 341, 342, 343, 401, 402.

The degree Master of Science may be earned on either a thesis or nonthesis basis. The nonthesis option requires the completion of at least 51 credits of acceptable graduate work and satisfactory performance on a written examination.

There is no uniform language requirement for graduate students majoring in statistics. The department encourages the students to prepare themselves in foreign languages and in computer language, but specific requirements for the degrees Master of Science and Doctor of Philosophy are at the discretion of the student's advisory committee.

Open to graduate students for minor credit only: 401, 402, 403, 411, 421, 431, 436, 447, 448, 481, 482.

Courses Primarily for Undergraduate Students

100. Orientation in Statistics. (1-0) Cr.; R. Survey of the field for students planning or considering a career in statistics.

*101. Principles of Statistics (3-0) Cr. & F.W.S. Statistical concepts in modern society; frequency distributions; elements of statistical inference; contingency tables; introduction to regression, correlation; analysis of variance, single classification.

*104. Introduction to Statistics (3-0) Cr. & W.S. Statistical concepts with emphasis on experimental problems from biological fields. For students in agricultural and biological sciences.

*105. Introduction to Statistics (3-0) Cr. 3. F.S. Prerequisite: Math 120 or 130. Statistical concepts with emphasis on engineering applications; Probability; elements of statistical inference; introduction to order statistics. For students in engineering.

*127. Business Administration Statistics (4-3) Cr. & F.W.S. Obtaining, presenting, and organizing statistical data; measures of location and dispersion; the normal distribution; regression and correlation; time series analysis; index numbers; sampling and sampling distributions; tests of hypotheses.

327. Elementary Business Statistics. (3-3) Cr. 4. F. Prerequisite: 101 or 127. Application of statistical methods to business data obtained from random samples and from time series; inference, decision theory, quality control, index numbers, forecasting, and simple Markov processes.

341, 342, 343. Introduction to Theory of Probability and Statistics. (3-0) Cr. 3 each. Yr. Prerequisite: Math 122 or 132. Probability; distribution functions and their properties; sampling distribution; theory of estimation and hypothesis testing; linear hypothesis theory, regression and correlation; the multivariate normal distribution; nonparametric methods.

380. Statistical Applications of Digital Computers. (Com S 380) (2-3) Cr. 3. F.W.S. Prerequisite: 101; Com S 201 or knowledge of computer programming. Techniques for using the computer as a tool in the analysis of statistical problems. The department recommends that credit in both 380 and 481 not be awarded toward graduation.

401, 402. Statistical Methods for Research Workers (3-0) Cr. 4 each. 401: F.W.S.; 402: W.S.S.I. Prerequisite: 401: 101 or graduate classification, 5 credits in mathematics; 402: 401. The role of statistics in research. Introduction to the methods of analyzing data from experiments and surveys. 401: Statistical concepts and models; statistical inference; testing hypotheses; introduction to regression and correlation; introduction to analysis of variance. 402: Methods of analysis of variance including cross classifications; introduction to multiple comparisons; factorial; individual degrees of freedom; multiple regression; covariance.

403. Nonparametric Statistical Methods. (3-0) Cr. 3 Alt. F., offered 1974. Prerequisite: 401. Analytical procedures for statistical data when the dependent variable has ordinal or nominal properties; elaborations of chi-square procedures; randomization procedures for ranked data and data having interval properties; efficiency of nonparametric procedures and robustness of comparable parametric procedures.

411. Experimental Design for Research Workers. (3-0) Cr. 3. S.S.S.I. Prerequisite: 402. Methods of constructing and analyzing designs for experimental investigations; concepts of blocking, randomization, and replication; experimental unit technique; complete block designs; confounding in factorial experiments; incomplete block designs; response surface methodology.

421. Survey Designs for Research Workers. (3-0) Cr. 3. S.S.S.I. Prerequisite: 401. Methods of constructing and analyzing designs for survey investigations; simple random, stratified, multistage, and multistage sampling designs; questionnaire construction; methods of estimation; techniques of survey investigation.

431. Elementary Statistical Quality Control. (3-0) Cr. 3. S. Prerequisite: 101 or 401; junior classification. Application of statistical principles to manufacturing. Survey of control chart technique and sampling inspection schemes now in use.


The department recommends that credit for only one of the courses 101, 104, 105, 127 be applied toward graduation.
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 nonlinear regression; extension of chi-square applications.

505. Psychometrics. (Psych 505) (3-0) Cr. 3. S. Prerequisite: 402, Psych 440. Wolina. Theories of psychological scaling and measurement; derivation of formulas used in reliability experiments; useful approximation procedures.

520. Sociometric Statistics. (3-0) Cr. 3. F. Prerequisite: 402. Warren. Sociological models, including linear models, and their applications to sociological data. Criteria, selection of predictor variables, estimation, dummy variables, residuals, and causal inference. Methods of sociological scaling, index construction, and composite measures.

511, 512. Design of Experiments. (3-0) Cr. 3 each. 511: W.; 512: S. Prerequisite: 401; 448 or 541. Zyskind. Advanced theory of least squares; classifier and functional models; estimability, missing observation procedures and the analysis of variance and covariance.

521. 522. Design of Surveys. (3-0) Cr. 3 each 521: W.; 522: S. Prerequisite: 521; 401, and 448 or 541; 522: S. Han, B.V. Sukhatme. Comprehensive account of sampling theory as developed for use in sample surveys; simple random, stratified, systematic, cluster, and multistage sampling; estimation; multiple estimation, including ratio and regression techniques; nonsampling errors; descriptive vs. analytical surveys.

531. Industrial Statistics: Process Control. (1 E 531) (3-0) Cr. 3. Alt. F., offered 1974. Prerequisite: 343 or 443. Menzeng. Sequential analysis; continuous sampling plans; statistical process control; cost functions and Bayes' procedures.

533. Industrial Statistics: Reliability. (1 E 533) (3-0) Cr. 3. Alt. F., offered 1973. Prerequisite: 343 or 443. Menzeng. Probabilistic aspects of reliability models; inference for reliability parameters; design of multicomponent systems; replacement and inspection policies.

535. Biological Statistics. (3-0) Cr. 3. S. Prerequisite: 402. C.P. Cox. Direct and indirect biological assay; dose response curve; parallel line and slope ratio assay; crossover design; multiple assays; quantal responses; probit analysis.

539. Econometric Statistics. (Econ 538) (3-0) Cr. 3. F. Prerequisite: 448. Fuller. Generalized linear regression models, dummy variables; miscellaneous estimation problems, autocorrelated errors, errors in variables, multicollinearity; estimation of parameters in simultaneous equation systems.

539. Operations Research. (Econ 539, I E 539) (3-0) Cr. 3. W. Prerequisite: 349 or 448. Mensing. Topics in game theory, programming, and the theory of queues.

540. Operations Research Methods and Economic Analysis. (Econ 540, I E 540) (3-0) Cr. 3. Alt. S., offered 1974. Prerequisite: 448 or Math 122, and Econ 539. Sengupta. Methods and applications of selected techniques in nonlinear programming, including geometric, stochastic and variational programming. Applications emphasis problems of specification in economics and operations research.


559. Nonparametric Statistical Theory. (3-0) Cr. 3. S. Prerequisite: 542. S. Sukhatme. Introduction to nonparametric problems; one-sample, two-sample, and c-sample problems; order statistics and their applications; rank tests, tests for location and dispersion, and their large sample properties; tests based on sample distribution functions; asymptotic relative efficiency of nonparametric tests.

549. Mathematical Programming. (3-0) Cr. 3. S. Prerequisite: 539 or Econ 537. Spottiswoode. Techniques for determining the optima of linear and nonlinear models including linear, integer, quadratic, convex, and geometric programming applied to economic, engineering, and statistical problems.

554. Probability. (Math 554) See Mathematics.


560. Statistical Computations on Digital Computers I. (Com S 560) (3-0) Cr. 3. W. Prerequisite: 402; 442 or 448; 542; Math 307, Com S 201 or knowledge of Fortran. Kennedy. Programming techniques and methods for solution of problems in multiple linear regression, nonlinear regression, analysis of variance.

561. Statistical Computations on Digital Computers II. (Com S 561) (3-0) Cr. 3. S. Prerequisite: 560, and Math 409 or 414. Kennedy. Topics in the use of statistical and computer techniques in statistical analysis; evaluating statistical distribution functions, Monte Carlo techniques, programming symbolic operations.
Courses for Graduate Students, major or minor

601. Advanced Statistical Methods. (3-0) Cr. 3. F. Prerequisite: 501, and 448 or 543. C.P. Cox. Principles of regression analysis; general orthogonal polynomials; multivariate analysis including Hotelling's T2; the linear discriminant function and the analysis of dispersion; regression nonlinear in the parameters; seminars on special topics.

602. Seminar on Statistical Methods. Cr. var. Prerequisite: 501; 448 or 543.

611, 612. Advanced Design of Experiments. (3-0) Cr. 3 each. 611: Alt. W.; 612: Alt. S., offered 1975. Prerequisite: 512, 641. Kempthorne. Randomization theory of designs; general theory of factorial designs; fractional replication; theory of quasi-factorial 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 1974. Prerequisite: 522, 543. Han, B.V. Sukhatme. 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 nonsampling errors.


642. Probability and Distribution Theory. (3-0) Cr. 3. W. Prerequisite: 545, Math 614. Probability measure and distribution functions; random variables; characteristic functions; asymptotic distributions.

643. Theory of Estimation and Testing of Hypotheses. (3-0) Cr. 3. S. Prerequisite: 543. Neyman-Pearson theory of testing hypotheses; point and interval estimation; sufficient statistics; elements of decision theory.

644. Sequential Statistical Decision Theory. (3-0) Cr. 3. Alt. F., offered 1874. Prerequisite: 543, 544, one course in probability. H.T. David. Several-source sequential analysis, optimal step rules, Markovian sequential decision models.

646. Time Series. (Econ 646) (3-0) Cr. 3. Alt. S., offered 1975. Prerequisite: 448 or 543. Fuller. Stochastic processes; covariance and spectral representations; moving average and auto-regressive schemes; Fourier and periodogram analyses; serial correlations; analysis of trend, seasonal variations, and cyclical variations.


649. Recent Developments in Statistics and Probability. (3-0) Cr. 3. Prerequisite: 642, 643. Material selected from an area of research such as sequential analysis, decision theory, nonparametric inference, stochastic processes.

661. Theories of Inference. (3-0) Cr. 3. SSI. Prerequisite: 543, one 600-level course in statistics. Kempthorne. Review of basic aspects, condensation of data, sufficiency, the likelihood function, Bayes' theorem, past rejection of Bayesian processes, statistical tests and problems and obscurities, statistical intervals, problems of validity, likelihood inference, recent Bayesian inference, review of basic writings.

680. Seminar on Statistical Computations. Cr. var. F. Prerequisite: 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.

Surveying and Mapping

Rolland L. Hardy, Professor in Charge

The surveying and mapping program is administered by the Department of Industrial Engineering in cooperation with the Department of Civil Engineering. It leads to the degree of Bachelor of Science with major in engineering operations.

This program is designed for students who desire a broadly based knowledge of surveying and mapping. Graduates of this program should find opportunities with consulting firms involved in aerial surveying and mapping, and in land surveying.

Other career opportunities exist in industry and government. Employment by industry frequently involves research, development, and testing of advanced geodetic and photogrammetric systems. Federal, state, and local government activity includes national geodetic and mapping programs, public land surveys, natural resources exploration, control of land use, subdivision design review, and other administrative or legal control matters.

The required courses in the surveying and mapping program include all the required courses and group requirements in the engineering operations curriculum. The following number of credits in surveying, mapping, and related courses are also required:

| Credit in surveying and mapping at the 300 level or above | 27 |
| Credit in related science, engineering, or technology | 15 |

The 27 credits in surveying and mapping may be used to satisfy the engineering operations group requirement for sequences in an engineering area. The 15 credits in related science, engineering, or technology must be in courses beyond those used to satisfy any of the group requirements in the regular engineering operations curriculum. Also, these courses must be approved in advance by the professor in charge of the program.

The minimum requirement for graduation in the surveying and mapping program is 195 credit hours.
Telecommunicative Arts
For description of courses, see Speech.

Textiles and Clothing

Margaret C. Warning, Head of Department

Professors: Hollen (Emeritus), Huepenbecker, Potgieter (Emeritus), Saddler, Winakor.
Associate Professors: Danielson, Hall, Kundel.
Assistant Professors: Ingels, Javier, LaGrange, Lewis, Shibles, Williams, Yep.
Instructors: Brackelsberg, Buck, Goings, Kunz, Occelli, Robison, Seifert, Shaw.

Undergraduate Study

Courses in textiles and clothing furnish knowledge and training essential to the consumer for providing clothing and household fabrics for the individual, the family, and the home. The aesthetic, economic, sociological, psychological, scientific, and cultural aspects of textiles and clothing are stressed.

The department offers work for the degree Bachelor of Science with majors in textiles and clothing, and textiles and clothing and related science. These majors, and the two options within each, provide preparation for many different kinds of positions and a basis for advanced study.

The major in textiles and clothing offers two options: design and merchandising. Option 1, design, is planned for those interested in the aesthetic aspects of textiles and clothing and in apparel or textile designing. Option 2, merchandising, is planned for students interested in the marketing of textile and clothing products by retailers and manufacturers, and in developing and distributing textile and clothing information to consumers. Supervised work experience is recommended strongly.

The major in textiles and clothing and related science is designed for those who wish to prepare for advanced study leading to careers in college teaching or in research. Option 1 enables the student to emphasize the physical sciences, thereby laying the foundation for further study and for research in textiles. Option 2, the social science option, is designed for the student interested in the economic, sociological, or psychological aspects of clothing and textiles.

Graduate Study

The department offers work for the degree Master of Science with major in textiles and clothing, and minor work to students taking major work in other departments.

Prerequisite to major graduate work is the completion of courses in applied art, chemistry (including inorganic and organic), economics, textiles and clothing (including specific courses in general textiles, clothing construction, and costume designing). Additional prerequisites may be required, depending upon the nature of the work the student wishes to pursue.

The foreign language requirement will be established at the discretion of the student's advisory committee.

Open to graduate students for minor credit only: 404, 429, 454, 455, 464, 465.

Courses Primarily for Undergraduate Students


122. Introduction to Pattern Making. (3-7) Cr. 4. F.W.S. Prerequisite: 121. Basic pattern making techniques as they are used by commercial pattern companies and apparel manufacturers. Basic information for understanding pattern designing, pattern alteration, and fitting of garments.

204. Textiles. (3-3) Cr. 4. F.W.S. SS. Fundamental weaves, yarn, fibers, color, and finishes with reference to selection of fabrics in relation to end use.

210. Sophomore Seminar. (2-0) Cr. 1. F.W.S. Prerequisite: Sophomore or transfer standing. Orientation to textiles and clothing; professional opportunities.

222. Pattern Making and Clothing Construction. (2-7) Cr. 4. F.W.S. SS. Prerequisite: Placement test- X classification or 121. The use of commercial basic patterns and development of foundation patterns; flat pattern designing and related garment construction; making patterns for and constructing selected dress design in appropriate fabric.

223. Draping. (2-7) Cr. 4. F.W.S. SS. Prerequisite: 121 or placement test-X classification. Draping with emphasis on designing, fitting, and construction.

245. Clothing Selection. (2-3) Cr. 3. F.W.S. SS. Selection of appropriate and becoming clothing for individuals, with recognition of social, economic, and design factors.

304. Applied Textiles (4-0) Cr. 4. F.W.S. SS. Prerequisite: 204. Application of basic principles of textiles in specific end uses; household textiles, clothing, nonwoven textiles; emphasis on serviceability, aesthetic, economic, and psychological aspects.


375. Textiles and Clothing Merchandising. (3-0) Cr. 3. F.W.S. Prerequisite: 1 Ad 340 or Eco 485. Principles of merchandising as applied to clothing, accessories, and household textiles.

404. Advanced Textiles. (3-0) Cr. 3. F.W.S. Prerequisite: 304. Chem 231, 233C. New developments in the textile field as reported in current literature.
419. Textiles and Clothing Department Seminar (2-0) Cr. 1. F.W.S. Prerequisite: Senior standing. Satisfactory/fail only.

429. Custom Tailoring (2-0) Cr. 4. F.W.S. Prerequisite: 122 or 222 or 223. Custom tailoring techniques applied in making women’s suits and coats.

430. Custom Dressmaking (0-0) Cr. 3. S. Prerequisite: 222, 223, 345, senior classification. Designing, making patterns and sewing for a selected clientele. A business approach to sewing.

454. History of Costume (3-0) Cr. 3. F.S. Alt. S. Prerequisite: Hist 201, 202. Styles of costume in western civilization from ancient times to the present day; cultural and economic factors associated with the development, adoption, and abandonment of styles.

455. Historic Textiles (3-0) Cr. 3. F.W.S. Alt. S. Prerequisite: 204, Hist 201, 202. Development of textiles from ancient times; a study of specific historic textiles; contemporary interpretations of historic textile designs.

464. Family Clothing Consumption (3-0) Cr. 3. F.W.S. Alt. S. Prerequisite: 304, Econ 241, 242. Current theories of clothing consumption; factors affecting family clothing expenditure; production and distribution of textile and clothing products for the consumer market.

465. Sociological and Psychological Aspects of Clothing and Textiles I (3-0) Cr. 3. F.W.S. Prerequisite: 204, 245, Psych 101, Soc 134. Origins and functions of clothing and textiles. Uses and meanings of clothing and dress over time and in contemporary society.

470B, 470D, 470G. Supervised Experience. Cr. 2 to 8. Prerequisite: Recommendation of department. 470B: Nine to 12 credits from 454, 465, 466, 480B, 480E; 6 credits in anthropology strongly recommended. 470D: Junior or senior classification, 345, at least 12 credits in pattern making and construction. 470G: Junior or senior classification with previous retailing experience; Econ 466 or Econ 340 strongly recommended. Supervised work experience in a cooperating retail or manufacturing firm, design studio, or museum. 470B: Historic textiles and clothing; 470D: Costume design and manufacture; 470G: Merchandising.

490. Senior Study Tour. A, B; Cr. R; C: Cr. 1. A-F.; B, S, C: Between W. and S. Prerequisite: Credit or classification in 454 or 455, junior or senior classification. Study of and visits to mills, factories, dress houses, stores, museums, and laboratories.

490. Special Problems. Cr. 1 to 4 per quarter. Prerequisite: Ten credits in textiles and clothing, permission from the department head and instructor.

A. Textiles and Textile-Related Research.
B. Historic Textiles.
C. Clothing Construction.
D. Costume Design.
E. History of Costume.
F. Sociological and Psychological Aspects of Textiles and Clothing.
G. Economic Aspects of Clothing.
H. Honors.

525. Advanced Patternmaking (2-4) Cr. 3. S. Alt. S. Prerequisite: 222, 223, 345. Application of design and pattern-making principles to various fabrics and styles.

526. Theory of Pattern Drafting and Designing (3-0) Cr. 3. F.S. Prerequisite: 222, 223, senior or graduate classification. Analytical study of commercial pattern characteristics. Drafting of personal basic pattern or "block" and application of drafting principles to a figure with fitting problems. Pattern designing on the drafted "block."

529. Experimental Tailoring (2-4) Cr. 3. S. Prerequisite: 429 or equivalent, senior or graduate classification. Study of an experiment in tailoring techniques as applied to various fabrics used in coats and suits.

545. Advanced Costume Design (2-4) Cr. 3. F.S. Prerequisite: 435. A visual and theoretical analysis of the costume-body form; application of this analysis to specific group and individual design problems.

554. Advanced History of Costume (2-1) Cr. 3. W. Prerequisite: 444, senior or graduate classification. Study of garments in the historic collection and their relationship to other sources of information; research techniques; individual study of selected periods.

566. Sociological and Psychological Aspects of Clothing and Textiles II (3-0) Cr. 3. W.S. Prerequisite: 465. Readings in and investigation of social and psychological aspects of clothing and textiles. Written and oral reports of research and readings.

590. International Study Tour. Cr. 1 to S. Prerequisite: Junior, senior, or graduate classification; 444, 445. A short period of orientation (lectures, films, discussion, short field trips, and study) before travel to observe garments and textiles in mills, factories, homes, stores, laboratories, and museums. Countries studied and visited will vary.

590. Special Topics. Prerequisite: Permission of the department head and professor or professors concerned.

Courses for Graduate Students, major or minor

610 Seminar. Cr. arr. W.

699. Research.
University Studies
George C. Christensen, Vice President for Academic Affairs

Certain interdisciplinary courses are offered through University Studies, at the discretion of the Vice President for Academic Affairs and the University Curriculum Committee. No major is available in university studies, but credit obtained through university studies offerings may be applied toward a degree in any of the colleges, consistent with the stipulations of the student's curriculum.

Requests to make use of university studies 101, 102, 103, 290, 301, 302, 303, and 490 should be directed to the Vice President for Academic Affairs and should be accompanied by a positive recommendation from the department heads and deans of the instructors making the request. The University Curriculum Committee will consider all requests and recommend to the Vice President regarding their disposition after consultation with relevant college and University committees.

Courses for graduate credit must receive approval from the Graduate Curriculum and Catalog Committee. The remaining university studies courses are the responsibility of various university committees, as indicated.

Courses Primarily for Undergraduate Students

101, 102, 103. Interdisciplinary Studies. Cr. var. Yr. Experimental interdisciplinary courses offered by an interdepartmental group. Intended primarily for freshmen and sophomore offerings.


301, 302, 303. Interdisciplinary Studies. Cr. var. Yr. Experimental interdisciplinary courses offered by an interdepartmental group. Intended primarily for junior and senior offerings.

311, 312, 313. Seminar 73, 74. (1-0) Cr. 1 each time elected. Yr. Multidisciplinary seminars focusing on current social issues. Leaders from University faculty, community, business and industry. Emphasis on student-faculty inquiry with opportunity for discussion. Offered on a satisfactory-fail basis only.

321H, 322H, 323H. University Honors Seminar. (3-0) Cr. 1 or 2 each time elected. Yr. Prerequisite: Membership in the University Honors Program. Interdisciplinary seminars on topics to be announced in advance. Offered on a satisfactory-fail basis only.

420. Environmental Studies. Cr. var. Multidisciplinary courses sponsored by the Environontology Council that examine major environmental problem areas from a broad systems perspective.

430. Seminar in International Studies. (3-0) Cr. 3. F. W.S. Prerequisite: Major in international studies. Other students may be permitted to enroll if space is available. Seminar in International Studies, sponsored by the International Studies Committee and offered by faculty from throughout the University. Intended primarily for juniors and seniors.

437. Foreign Study. Cr. var. F.W.S.S.S. Prerequisite: Permission of chairman of the International Studies Com-

Urban Planning

Frank W. Osgood, Professor in Charge
Professor: Fitzsimmons.
Associate Professor: Malone.
Assistant Professors: Lex, Parks, Simmons.

Undergraduate Study
For undergraduate curriculum in urban planning leading to the degree Bachelor of Science, see College of Agriculture, Curricula.

Urban and regional planning is concerned with the economic, social, physical, psychological, and management aspects of change in a geographic or political area. The planner must attain a broad comprehension of city, metropolitan, urban and rural region, and state-wide types of development, their interrelationships, and the extent of their changing needs over the short-term, middle-, and long-range future.

Graduate Study
The program in urban planning, which is administered by the Department of Landscape Architecture, offers work for the degree Master of Science with major in town and regional planning. Minor work is offered to students taking major work in other departments. The degree Master of Science, major in town and regional planning, is granted upon completion of two years of graduate study with a minimum of 60 credits in residence at Iowa State University and a total of 77 credits.

By taking work in urban planning and in areas offered by other departments a student may develop programs with special emphasis on administration; economic planning; resource conservation; urban renewal; transportation planning; urban design; human resources planning; housing; systems analysis; and state and regional planning.

For the degree Master of Science, the foreign language requirement, if any, is established on an individual basis by the program of study committee.

Satisfactory completion of the core requirements and the acceptance of a thesis (12 credits) is required
for the M.S. degree. In addition, the student is expected to complete 3 months of acceptable work experience in a planning office between his first and second year.

Open to graduate students for minor credit only: 380, 383, 395, 432, 433, 492.

The department also participates in the interdepartmental program in housing. (See Housing)

Courses Primarily for Undergraduate Students

110. Orientation in Urban Planning. (1-0) Cr. R. \( v \) F. Survey of urban planning and allied fields.

112. Graphic Communication (L A 112) See Landscape Architecture

153. Survey of Urban Planning. (3-4) Cr. 3. W.S. A historical survey of planning, the nature and problems of urban areas, and the goals, procedures, and results of urban planning.

210. Planning Seminar. (1-0) Cr. L. F. Prerequisite: Sophomore standing and major in urban planning. Seminar on the planning office and planning administration. Offered concurrently with Ur Pl 110 and Ur Pl 510.

270. Forces Shaping Our Urban Environment. (3-0) Cr. 3. W. Introduction to the social, political, physical, and economic forces shaping urban areas and their interrelationships. Gives a comprehensive picture of planning in urban development by showing important roles other urban disciplines play in the planning process and the interrelationships of these disciplines.

272. Planning Analysis and Techniques. (4-0) Cr. 4. W. Prerequisite: 153 or 270. An introduction to existing and emerging techniques for the preparation and criticism of plans and planning. Topics covered include economic, population, activity, and physical studies, and studies for the location, quantity, intensity and timing of land uses and public services. Exercises in the use of sources and techniques.

310. Planning Seminar. (1-0) Cr. 1. F. Prerequisite: Junior standing and major in urban planning. Seminar on the planning office and planning administration. Offered concurrently with Ur Pl 110 and Ur Pl 210.

390. State and Regional Planning. (4-0) Cr. 4. F. Prerequisite: 153 or 270. State and regional planning; development of state and regional planning. Advanced theory of urban planning as an art and a science. Land development models for planning purposes based on the theories from which the models derive. Value conflicts in urban planning and arrangements for accommodating these conflicts.

393. Theory of the Planning Process. (4-0) Cr. 4. W. Prerequisite: 153 or 270. The nature of 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; relations of facts and values.

395. Housing and Urban Renewal. (3-0) Cr. 3. S. Prerequisite: 153 or 270. Guidelines for housing policy formulation as a part of the over-all planning process in urban areas. Includes analysis of housing needs, regulation, stimulation, renewal, and replacement of housing through public policy. The urban renewal process; analysis of various urban renewal programs; residential conservation, rehabilitation, and redevelopment; and commercial and industrial renewal.

432. Urban Development Planning. (0-9) Cr. 3. W. Prerequisite: Senior standing and permission of instructor. Preparation of a comprehensive plan, including alternatives. Preparation of selected effectuating devices for one or more of these alternative plans.

433. Urban Development Programming. (0-9) Cr. 3. S. Prerequisite: 452, or senior standing in other curriculums, and permission of instructor. The programming of plans through time, by such means as community renewal pro-

rogramming and urban renewal projects, and planning-programming-budgeting procedures.

490. Special Problems. Cr. 2 to 4. Prerequisite: Permission of instructor. Investigation of an approved topic commensurate with student's interest and ability. Offered only on a satisfactory-fail basis.

H. Honors Program.

492. Planning Law, Administration and Implementation (5-0) Cr. 5. F. Prerequisite: 153 or 270. The basis in constitutional, common, and statute law for the powers and duties of planning authorities and the powers of plan enforcement. Problems of balancing public and private interest as revealed in study of leading court cases. The administration of planning agencies and programs.

498. Senior Urban Research. Cr. 3. F. Prerequisite: Senior standing and major in urban planning. Independent research on an approved topic within the specialization area pursued by the urban planning major.

Courses Primarily for Graduate Students, major or minor, open to qualified undergraduates

511. History and Development of Planning. (2-0) Cr. 2. F. Evolution of planning in the United States and other selected countries to relate current status and future potentials. Relates urbanization process to history and development of planning to meet local, metropolitan, regional, state, and national needs.

512. Urban Planning Profession. (1-0) Cr. L. W. Prerequisite: 511. Various elements of public planning and the planning office, including comprehensive plan, zoning, planning commission, urban renewal, housing authority, planning administration, and other important aspects of the planning profession.

513. Seminar. (1-0) Cr. 1. S. Prerequisite: 512

531. Metropolitan Planning Workshop. (0-9) Cr. 3. S. Preparation of a comprehensive plan for a metropolitan area or region.

532. Inner City Planning Workshop. (0-9) Cr. 3. F. Analysis of problems confronting inner-city neighborhoods accompanied by a study of possible actions that might be taken to achieve identified objectives.

533. Urban Educational Workshop. (0-9) Cr. 3. W. The study and analysis of experimental concepts postulated to improve man's urban environment. Concepts to be considered for examination will vary.

541. Urban Planning Research Methods. (2-3) Cr. 3. S. Research methods for the discovery of new knowledge in urban and regional planning. Research of various types and sources of data and information systems.

541. Theory of Urban Planning. (3-0) Cr. 3. W. Prerequisite: Econ 462 or graduate classification in town and regional planning. Planning concepts; planning and programming of physical plans. Emphasis on new techniques derived from advanced planning theory.

575. Urban Planning/Urban Management. (3-0) Cr. 3. S. An examination of the role planning plays in the management and decision making process. Topics receiving particular attention includes: planning-programming-budgeting theory and techniques, urban systems analysis, policy planning, and urban information systems.
Courses for Graduate Students, major or minor

614. Seminar. (1-0) R; S. Prerequisite: 513.
698. Research.

Veterinary Anatomy

James H. Magilton, Acting Head of Department

Professors: Cholvin, Christensen, Magilton.
Associate Professors: Bal, Carithers, Ghoshal, Skold.
Assistant Professors: Draper, Hillmann.

Undergraduate Study

For undergraduate curriculum in veterinary medicine leading to the degree Doctor of Veterinary Medicine, see Veterinary Medicine, Curriculum.

Through courses in this department, veterinary students acquire a detailed knowledge of the anatomy of the domestic animals which is necessary for a proper understanding of physiology, pathology, diagnosis, surgery, and medicine.

Graduate Study

The department offers work for the degrees Master of Science and Doctor of Philosophy with major in veterinary anatomy, and minor work for students majoring in other departments. Within the veterinary anatomy major the student may specialize in microscopic anatomy and macroscopic anatomy.

Instruction and research facilities in biomedical engineering are provided jointly by the departments of Electrical Engineering, Veterinary Anatomy, and Veterinary Physiology and Pharmacology. See Biomedical Engineering for requirements.

Prerequisite to major graduate work is the completion of an undergraduate curriculum substantially equivalent to that in veterinary medicine.

Research is encouraged in gerontology, experimental neuroanatomy, advanced veterinary microscopic organology, surgical anatomy, advanced anatomy for biomedical engineering, gross anatomy, and ultrastructure of cells and tissues.

There is no language requirement for the degree Master of Science. For the Doctor of Philosophy degree, the student is required to successfully complete or pass by examination three quarters of a single foreign language. Students whose native language is not English may substitute competence in English.

Open to graduate students for minor credit only: 404.

Courses Primarily for Undergraduate Students

217. Anatomy of Domestic Animals. (3-0) Cr. 3. F.W. For second-year students in agriculture, and other advanced students desiring fundamental knowledge of anatomy.

301. Microscopic Anatomy. (3-8) Cr. 6. F. Prerequisite: First year classification in veterinary medicine. Cytology, basic tissues, and developmental anatomy.

302. Microscopic Anatomy. (3-8) Cr. 5. W. Prerequisite: 301. The body systems and organogenesis.

303. Microscopic Anatomy. (1-6) Cr. 4. S. Prerequisite: 302. The body systems, endocrines, and fetal membranes.

311. Gross Anatomy. (3-12) Cr. 7. F. Prerequisite: First year classification in veterinary medicine. Systematic and topographic study and dissection of the dog.

312. Gross Anatomy. (3-9) Cr. 6. W. Prerequisite: 311. Systematic and topographic study and dissection of the horse, ruminant, pig, and comparative neurology.

313. Gross Anatomy. (1-11) Cr. 5. S. Prerequisite: 312. Systematic and topographic study and dissection of the horse, ruminant, pig, and chicken.

404. Systematic Anatomy. (1-6 or 12) Cr. 3. Cr. 5. Each time taken. S. Prerequisite: One year of college biology, permission of instructor.

A. Ruminant Anatomy. Cr. 5.
B. Nonruminant Anatomy. Cr. 5.
C. Anatomy for Biomedical Engineering. Cr. 3.
D. Avian Anatomy. Cr. 3.

449. Laboratories in Surgery and Surgical Anatomy. (V C S 449) (1-8) Cr. 3. F.W. & S. Prerequisite: Third year classification in veterinary curriculum.

490. Special Problems. Cr. 1 to 6 each time taken. Prerequisite: Permission of department head.

Courses Primarily for Graduate Students, major or minor, open to qualified undergraduates

Veterinary Clinical Sciences

Wallace M. Wass, Head of Department

Professors: Emmerson, Herrick, Lundvall, Preston.
Associate Professors: Clark, DeYoung, Grier, Kunesh, Newton, Sexton.
Assistant Professors: Carithers, Chastain, Eness, Evans, Hoefle, Haskins, Hull, Jackson, Johanns.
Instructors: Haji, Juelsgaard, Kincaid, McLeish, Reese.

Undergraduate Study

For undergraduate curriculum in veterinary medicine leading to the degree Doctor of Veterinary Medicine, see Veterinary Medicine, Curriculum.

The study of medicine and surgery summarizes and illustrates the application in practice of the training previously received in anatomy, physiology and pharmacology, pathology, and microbiology. On completion of the senior year, the student has not only the theoretical knowledge, but some of the more practical methods of applying such knowledge. The transition from the student to the practitioner presents little difficulty after such training.

The department presents course work in animal reproduction dealing with interferences with parturition, diseases of the newborn, and interferences with normal reproduction commonly termed infertility.

A systematically organized course in radiology is presented, emphasizing the handling, exposing, processing and interpreting of radiographs and the dangers of ionizing radiation to man and animal when improperly used.

Graduate Study

The department offers work for the degree Master of Science with major in veterinary clinical science, and minor work for students majoring in other departments. Within the veterinary clinical sciences major, the student may specialize in veterinary medicine, surgery, radiology, or reproductive diseases.

Both thesis and nonthesis options are available.

A satisfactory reading knowledge of one foreign language is strongly recommended. The Department uses the standardized examinations provided by Educational Testing Service for this purpose. However, the Department will accept meaningful collateral work in lieu of a foreign language if this is recommended by the student's committee.

Prerequisite to major graduate work is graduation from an approved College of Veterinary Medicine.

Courses Primarily for Undergraduate Students

391. Radiology. (3-0) Cr. 2. S. Prerequisite: Second year classification in veterinary curriculum. Essentials of radiology and radiobiology. Includes radiography, fluoroscopy and clinical and biological uses of X-radiation and radioisotopes, with special emphasis on protection from radiation and interpretation of radiographs.

397. General Surgery, (4-0) Cr. 4. S. Prerequisite: Second-year classification in veterinary curriculum. Fundamental principles of surgery.

441. Special Surgery I. (4-0) Cr. 4. S. Prerequisite: Third-year classification in veterinary curriculum. Surgical diseases of domestic animals.

442. Special Surgery II. (5-0) Cr. 5. S. W. Prerequisite: Third-year classification in veterinary curriculum. Surgical diseases of domestic animals.

444. Clinical Medicine I. (6-0) Cr. 6. F. Prerequisite: Third-year classification in veterinary curriculum. Clinical diagnostic methods and consideration of diseases of domestic animals.

448. Clinical Medicine III. (4-0) Cr. 4. S. Prerequisite: Third-year classification in veterinary curriculum. Clinical diagnosis and treatment of diseases of domestic animals.

447. Animal Reproduction Laboratory. (0-3) Cr. 1. F. W. S. Prerequisite: Third-year classification in veterinary curriculum.

446. Radiology Laboratory. (0-2) Cr. 1. F. W. S. Prerequisite: Third-year classification in veterinary curriculum.

445. Laboratories in Surgery and Surgical Anatomy. (V An 446) (1-0) Cr. 2. F. W. S. Prerequisite: Third-year classification in veterinary curriculum.

444. Disturbances of Reproduction. (4-0) Cr. 4. F. Prerequisite: Third-year classification in veterinary curriculum. General principles of diseases causing disturbances in reproduction.

443. Radiology. Cr. 1 to 12 each time taken. Prerequisite: Fourth-year classification in veterinary curriculum. Clinical assignments in veterinary radiology. Offered on a satisfactory-fail basis only.

442. Animal Reproduction. Cr. 2 to 12 each time taken. Prerequisite: Fourth-year classification in veterinary curriculum. Clinical assignments in animal reproduction. Offered on a satisfactory-fail basis only.

441. Small Animal Medicine. Cr. 2 to 12 each time taken. Prerequisite: Fourth-year classification in veterinary curriculum. Clinical assignments in small animal medicine. Offered on a satisfactory-fail basis only.

440. Small Animal Surgery. Cr. 2 to 12 each time taken. Prerequisite: Fourth-year classification in veterinary curriculum. Clinical assignments in small animal surgery. Offered on a satisfactory-fail basis only.


438. Veterinary Field Services. Cr. 2 to 12 each time taken. Prerequisite: Fourth-year classification in veterinary curriculum. Clinical assignments in veterinary field services. Offered on a satisfactory-fail basis only.

437. Special Problems. Cr. 1 to 5. Prerequisite: Permission of department head. H. Honors Program.

436. Seminar. Cr. R. Prerequisite: Fourth-year classification in veterinary curriculum. Seminars and case discussions on selected subjects by staff of the College of Veterinary Medicine and others, including student presentations. Offered on a satisfactory-fail basis only.

Courses Primarily for Graduate Students, major or minor, open to qualified undergraduates


590. Special Topics. Cr. 1 to 5. Prerequisite: Permission of instructor.

Courses for Graduate Students, major or minor

604. Seminar. Cr. 1. F. W. S.

640. Advanced Radiology. (2-8 or 9) Cr. 3 or 5. F. W. S. Prerequisite: 391. Detailed principles of clinical radiology with particular reference to radiographic interpretation.

671. Advanced General Surgery. (2-3 or 9) Cr. 3 or 5. F. W. S. Prerequisite: 442. An advanced course designed to investigate and discuss the responses of the body to surgical and anesthetic procedures.

672. Advanced Special Surgery. (2-3 or 9) Cr. 3 or 5. F. W. S. Prerequisite: 442. Advanced procedures in both clinical and research techniques are offered in abdominal, thoracic, orthopedic, cardiovascular, and neurological surgery.

673. Advanced Medicine. (3 or 5-0) Cr. 3 or 5. Alt. S., offered 1975. Prerequisite: 448. An advanced study of metabolic diseases.

674. Laboratory Animal Medicine and Pathology. (V Ph 678) (3-0) Cr. 3. Alt. SS., offered 1975. Prerequisite: 446. Detailed principles of medicine and pathology of laboratory animals.

696. Research.

Veterinary Medicine

Phillip T. Pearson, Dean

Durwood L. Baker, Associate Dean

Associate Professors: Flatt, Hutton.

Courses listed below are offered to undergraduate students in the College of Veterinary Medicine.

300. Professional Orientation. (1-0) Cr. R; F. Prerequisite: First-year classification in veterinary curriculum.

490. Special Problems. Cr. 1 to 3. Prerequisite: Classification in veterinary curriculum. Independent or small group study of a specific area for which no course is available in an existing department. H. Honors Program.

498. Professional Orientation and Jurisprudence. (3-0) Cr. 3. S. Prerequisite: Fourth-year classification in veterinary curriculum. Professional topics for the veterinarian.

498. Professional Orientation and Jurisprudence. (3-0) Cr. 3. S. Prerequisite: Fourth-year classification in veterinary curriculum. Professional topics for the veterinarian.
VETERINARY MICROBIOLOGY AND PREVENTIVE MEDICINE

R. Allen Packer, Head of Department

Professor: Hofstad, Kaelber, Mahtei, Dierks, Ross, Mart, Frey, Fer, Switzer.
Associate Professor: Hagle, Mohri, Gough.
Assistant Professor: Harris, Jensen.
Instructor: Potgieter.

Undergraduate Study

For undergraduate curriculum in veterinary medicine leading to the degree Doctor of Veterinary Medicine, see Veterinary Medicine, Curriculum.

The Department of Veterinary Microbiology and Preventive Medicine offers instruction in pathogenic bacteriology and mycology, animal virology, immunology, epidemiology, and public health. Regulatory and preventive veterinary medical aspects of the infectious diseases of animals are emphasized in courses for the student in the veterinary curriculum. Courses designed for students in agriculture deal with the principles of disease prevention in farm animals.

Graduate Study

The department offers work for the degree Master of Science with majors in veterinary microbiology and veterinary preventive medicine, work for the degree Doctor of Philosophy with major in veterinary microbiology, and minor work to students taking major work in other departments.

Prerequisite to major graduate work is the possession of the D.V.M. degree or the completion of an undergraduate program in biological science with emphasis in microbiology.

Knowledge of a language other than that native to the student is required. For the M.S. degree the student should have satisfactorily completed one year of college or university-level courses in a foreign language or must pass the ETS Graduate Student Foreign Language Examination at a score prescribed by the Department. For the Doctor of Philosophy degree, proficiency in two languages at the same level as for the M.S. degree, or proficiency in one language at a higher score is acceptable. An alternative for the Ph.D. requirement is the completion of two years of college or university-level courses in a foreign language. Students whose native language is not English may satisfy the language requirement by proving their proficiency in English. French, German, Russian or Spanish are approved as foreign languages for any student. Other languages may be approved by petition to the department.

The department also participates in the interdepartmental program of immunobiology. (See Immunobiology.)

Courses Primarily for Undergraduate Students

381. General Bacteriology and Immunology. (4-6) Cr. 6. Prerequisite: B & B 304, 305. Morphology, classification, and physiological characteristics of pathogenic bacteria; principles of infection and immunity.


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. History, etiology, epidemiology, laboratory diagnosis, regulatory control, public health and preventive medical aspects of the infectious diseases of animals.


435. Public Health II. (3-0) Cr. 3. S. Prerequisite: Third-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 300. A survey of diseases of large domestic animals, including a discussion of the causes, transmission, processes, and control. Designed for students majoring in agricultural sciences.

490. Special Problems. Cr. arr. Prerequisite: Permission of department head.

Courses Primarily for Graduate Students, major or minor, open to qualified undergraduates

529. Serology. (Immbo 520) (2-6) Cr. 4. F. Prerequisite: 381 or Bact 500. Kaelber. Principles of serology as applied to the diagnosis of infectious diseases and research in immunology.

532. Principles of Epidemiology. (3-0) Cr. 3. S. Prerequisite: 382, 383. Factors which influence the spread and perpetuation of animal diseases in animal and human populations.

538. Advanced Veterinary Virology. (3-4) Cr. 3. Alt. W., offered 1974. Prerequisite: 383 or Bact 408, permission of instructor. Marf. The study of pathogenesis and ecology of viral infections and the procedures for diagnosis and control of viral diseases.

590. Special Topics. Cr. 1 to 5. Prerequisite: 382.

Courses for Graduate Students, major or minor

604. Seminar. (1-0) Cr. 1. F.W.S. Packer.

652. Pathogenic Bacteriology. (3-6) Cr. 5. S. S. Prerequisite: 381, 382. Packer, Harris. Advanced study of the
VETERINARY PATHOLOGY

Frank K. Ramsey, Head of Department

**Professors:** Buck, Green, Greve, Lee, Monlux, Pope, Seaton, Zimmermann.

**Associate Professors:** Ball, Cassidy, Cheville, Dillman, Flatt, Hutton, Glock, Jeska, Kemp, Kluge, Ledet, Moon, O'Toole, Powers, Richter, Van Gelder.

**Assistant Professors:** Graham, Osweiler, Stahr.

**Instructors:** Andrews, Brown, Carson, Holter, Niyo.

**Undergraduate Study**

For undergraduate curriculum in veterinary medicine leading to the degree Doctor of Veterinary Medicine, see Veterinary Medicine, Curriculum.

The Department of Veterinary Pathology offers a systematic study of the dynamics of the disease process. Emphasis is placed on the manner in which disease brings about alterations in the anatomical structure and chemical and physiologic activities of animal cells, tissues, organs, and body systems. The application of these studies forms the basis for more accurate diagnosis which is essential for the treatment and prevention of animal diseases.

**Graduate Study**

The department offers work for the degrees Master of Science and Doctor of Philosophy with major in veterinary pathology, and minor work for students majoring in other departments. Within the veterinary pathology major the student may specialize in veterinary parasitology and veterinary toxicology.

A satisfactory reading knowledge of one language is strongly recommended for the Master of Science degree. A satisfactory reading knowledge of two languages or a comprehensive knowledge of one

language is strongly recommended for the Ph.D. degree. For students whose native language is not English, the ability to communicate adequately in English (certified by the Department of English) may be acceptable as a substitution for the reading knowledge of one foreign language. The department uses the standardized examinations provided by Educational Testing Service and administered by the University for determining the proficiency of the reading knowledge of a student in a foreign language.

It is possible to study for the degree Master of Science on a nonthesis basis. This option requires the completion of a minimum of 50 graduate credits, of which at least 15 must be earned in course work outside the department. The degree Master of Science with thesis requires the completion of a minimum of 45 graduate credits.

Prerequisite to major graduate work is the completion of an undergraduate curriculum leading to the degree Doctor of Veterinary Medicine.

Minor work is recommended in other departments of the College of Veterinary Medicine, and in bacteriology, biochemistry, cell biology, chemistry, zoology, entomology, physics, botany, genetics, psychology, or education.

The department also participates in the interdepartmental program of immunobiology. (See Immunobiology.)

**Courses Primarily for Undergraduate Students**

371. General Pathology. (3-4) Cr. & F. Prerequisite: V An 303, 313. Basic concepts of cellular and tissue response to disease.

372. Systemic Pathology. (4-4) Cr. & W. Prerequisite: 371. Tissue reaction to disease in the various body systems.

376, 377. Veterinary Parasitology. 376: (3-3) Cr. 4 W.; 377: (4-3) Cr. & S. Prerequisite: 376: 371; 377: 376. Parasites and parasitic diseases of animals and the principles of their control.

422, 423. Special Pathology. 422: (4-4) Cr. 6 W.; 423: (2-2) Cr. 3 S. Prerequisite: 422: 572; 423: 422. Pathogenesis of disease in mammalian and avian species.

426. Veterinary Toxicology and Poisonous Plants. (2-9) Cr. & S. Prerequisite: 422. A study of the diagnosis of diseases caused by and the mode of action of toxicologic compounds.


455. Interpretive Pathology. Cr. 1 to 12. Prerequisite: Fourth-year classification in veterinary curriculum.

A. Necropsy Laboratory.
B. Clinical Pathology.
C. Diagnostic Laboratory.

Graded satisfactory-fail only.

470. Radiology. (2-3) Cr. 3. Prerequisite: Minor or equivalent in biological sciences and 9 credits in physical sciences. O'Toole. Survey of the nature, medical uses, biological effects and ecological considerations of nuclear radiation and radiotopes.

480. Special Problems. Cr. 1 to 5 each time taken. Prerequisite: Permission of department head.

H. Honors Program.
Courses Primarily for Graduate Students, major or minor, open to qualified undergraduates

551. General Pathology. (3-4) Cr. 5. F. Prerequisite: V An 303, 313. Ramsey. Fundamentals of disease with emphasis on disease in animals.

554. Veterinary Toxicology. (3-0 or 4) Cr. 3 or 5. S. Prerequisite: 371. Buck, Van Gelder. Disease processes in animals caused by toxicants, differential diagnostic procedures, and identification of toxicants by laboratory tests.

557. 558. Veterinary Parasitology. 557: (3-3) Cr. 4. W.; 558: (4-3) Cr. 5. S. Prerequisite: 557; Permission of instructor; 558: 557. Greene, Kemp. Problems of parasitism in relation to animals.

560. Special Topics. Cr. 1 to 5. F.W.S.S. Prerequisite: Permission of instructor.
A. Veterinary Pathology.
B. Veterinary Parasitology.
C. Veterinary Toxicology.
D. Radiobiology.

Courses for Graduate Students, major or minor

604. Seminar. Cr. 1. F.W.S.S.


655. Pathophysiology of the Skeletal System. (3-0 or 4) Cr. 3 or 5. Alt. Yr. R. maximally and infectious diseases of bones and joints of animals.

656. Advanced Veterinary Pathology. (1-3 to 12) Cr. 2 to 6. F.W.S.S. Prerequisite: 977, 423
A. Experimental Pathology.
B. Histochemistry, Ball.
C. Advanced Post-Mortem Techniques.
D. Pathologic Hematology.
E. Mycotic and Parasitic Granulomatous Diseases. Ramsey.

657. Advanced Veterinary Toxicology. Cr. 2 to 5. Prerequisite: 654, 653. Buck, Van Gelder. Advanced study of specific toxicants as related to animal diseases, public health hazards, and the chronic effects of agricultural chemicals on animal tissues.
A. Neurotoxicology and behavioral toxicology.
B. Organic pesticides and heavy metals.
C. Toxic plant principles.
D. Food additives and trace elements.
E. Biotoxins.
F. Inhalation toxicology and toxic gases.

658. Advanced Veterinary Parasitology. (3-0 to 6) Cr. 3 to 5. Prerequisite: Permission of instructor. Greene, Kemp, Jeska, Zimmermann. Introduction to research in animal parasitology.
A. Topics in Protozoology.
B. Techniques in Parasitology.

660. Pathology of Parasitic Diseases. (3-4) Cr. 5. Alt. SS., offered 1974. Prerequisite: Permission of instructor. Greene, Kemp, Jeska, Zimmermann. A study of the gross and microscopic tissue changes caused by parasites.

678. Laboratory Animal Medicine and Pathology. (V C S 678) See Veterinary Clinical Sciences.

699. Research.
A. Veterinary Pathology.
B. Veterinary Parasitology.
C. Veterinary Toxicology.

Veterinary Physiology and Pharmacology

Melvin J. Swenson, Head of Department

Professors: Cholvin, Dougherty, Hembrough, Reche.
Associate Professors: Ahrens, Crump, Engen, Gillette, Kohlmeier, Kunesh, VanMeter, Wagner.
Assistant Professor: Ingraham.
Instructors: Eckhoff, Riedesel.

Undergraduate Study

For undergraduate curriculum in veterinary medicine leading to the degree Doctor of Veterinary Medicine, see Veterinary Medicine, Curriculum.

A thorough knowledge of basic physiology is imperative in order to understand physiologic changes encountered in metabolic and infectious diseases. In physiology courses the students make a detailed study of functions and activities of cells, tissues, organs, and systems constituting the animal body.

Pharmacology includes a systematic study of pharmacodynamics, toxicology, and clinical application of drugs. Each of these topics is given proper consideration in the courses in pharmacology with special emphasis on drugs and therapeutic practices important in veterinary medicine.

Graduate Study

The department offers work for the degrees Master of Science and Doctor of Philosophy with major in physiology (domestic animals) and minor work for students majoring in other departments.

Any foreign language acceptable to the student's advisory committee is approved for the degree Doctor of Philosophy. A grade of 500 is required on the Educational Testing Service examination to meet the requirement. There is no language requirement for the degree Master of Science.

Instruction and research facilities in biomedical engineering are provided jointly by the departments of Electrical Engineering, Veterinary Anatomy, and Veterinary Physiology and Pharmacology. See Biomedical Engineering for requirements.

Students expecting to do major work should have fundamental knowledge of physiology, matheatics, zoology, anatomy, physics, and chemistry.

Open to graduate students for minor credit only: 365, 367, 368.

Courses Primarily for Undergraduate Students

604. Physiology of Domestic Animals. (3-0) Cr. 3. W.S. Prerequisite: V An 217. For agricultural and other students who are interested in basic and applied animal physiology.

349. Comparative Mammalian Physiology. (4-3) Cr. 5. W. Prerequisite: Credit in V An 301 and 311. Physiology of blood, body fluids, excretion, respiration, acid-base bal-
ance, and muscle. Courses 349, 350, and 351 are designed for veterinary students.

350. Comparative Mammalian Physiology. (5-3) Cr. 6. Prerequisite: 349. Physiology of the nervous system and the cardiovascular system.

351. Comparative Mammalian Physiology. (5-3) Cr. 6. F. Prerequisite: 350. Physiology of digestion, absorption, metabolism, endocines, reproduction, and lactation.


387. General Pharmacology. (3-3) Cr. 4. F. Prerequisite: 350 or 583. General principles; pharmacology of drugs acting on the autonomic nervous system and central nervous system; neuromuscular blocking drugs, local anesthetics; toxicology. Courses 387-388 are designed for veterinary medical students and non-D.V.M. graduate students.

388. General Pharmacology. (3-3) Cr. 4. W. Prerequisite: 367. Pharmacology of specific classes of drugs including diuretics, endocines, antimicrobials, cardiac, and gastrointestinal drugs.

389. Pharmacology and Therapeutics. (3-0) Cr. 3. S. Prerequisite: 368. Pharmacological and therapeutic uses of vitamins, minerals, fluids, and antiparasitic drugs; clinical pharmacology of selected drugs.

490. Special Problems. Cr. 1 to 5 each time taken. Prerequisite: Permission of instructor. H. Honors Program.

Courses Primarily for Graduate Students, major or minor, open to qualified undergraduates

504. Seminar. Cr. 1. W. Prerequisite: Permission of instructor. Current concepts in research pertaining to physiology of domestic animals.


513. Central Nervous System Physiology. (3-3) Cr. 4. Alt. W., offered 1975. Prerequisite: Permission of instructor. Cellular considerations, neurotransmission, reflex arcs, synaptic inhibition in brain and spinal cord, electroencephalography and evoked potentials, and sleep.

561. Comparative Mammalian Anatomy and Physiology. (V An 561) (B M E 561) (3-3) Cr. 4. F. Prerequisite: Credit or classification in B & B 304 or 404. Integrated teaching approach for graduate students in basic anatomy and physiology. Designed for students in animal nutrition, biochemistry, engineering, food and nutrition, psychology, and other biological sciences. Same applies to 562 and 563. Cellular structure and function, nervous system, sensory systems, and muscle systems.

562. Comparative Mammalian Anatomy and Physiology. (V An 562) (B M E 562) (4-3) Cr. 4. W. Prerequisite: Credit or classification in B & B 305 or 405. Cardiovascular system, respiration, acid-base balance, and renal system.

563. Comparative Mammalian Anatomy and Physiology. (V An 563) (B M E 563) (3-3) Cr. 4. S. Prerequisite: B & B 305 or 405. Digestion, metabolism, reproduction, and endocrine system.


Inception, maintenance, and termination of pregnancy with particular emphasis on control mechanism. Endocrine regulation of fetal metabolism, growth, and development, Endocines, metabolic, and other interactions between fetus and dam. Parturition.

590. Special Topics. Cr. 1 to 5. Prerequisite: Permission of instructor. Special work in cardiovascular physiology, acid-base balance, digestion, endocrinology, hematology, myophysiology, neurophysiology, reproduction, renal physiology, respiratory physiology, nutritional physiology, and pharmacology.

A. Physiology.
B. Pharmacology.

Water Resources

Don Kirkham, Chairman,
Advisory Committee


Work is offered for the degrees Master of Science and Doctor of Philosophy with major in water resources under a cooperative arrangement with various departments including Agricultural Engineering, Agronomy, Bacteriology, Botany and Plant Pathology, Chemical Engineering, Civil Engineering, Earth Science, Economics, Family Environment, Food Technology, Forestry, Horticulture, 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. For the nonthesis Master of Science degree, 52 quarter credits are required.

Students majoring in water resources will choose a major professor from the graduate faculty membership of the cooperating departments and will develop the 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.

For the degree of Science and Doctor of Philosophy, the foreign language requirement, if any, is established on an individual basis by the student’s advisory committee.

Courses Primarily for Graduate Students, major or minor

501. Water Resources I (3-0) Cr. 3. F. Prerequisite: Permission of water resources advisory committee. Introduction to water resources planning. Hydrology: source, distribution, and movement of water and hydraulics of water control facilities.

502. Water Resources II (3-0) Cr. 3. W. Prerequisite: Permission of water resources advisory committee. Water resources planning. The role of quality in water resources: physical, chemical, and biological aspects of water and waste water.

503. Water Resources III (3-0) Cr. 3. S. Prerequisite: Permission of water resources advisory committee. Water resources planning. Legal, government, socioeconomic, administrative, and planning aspects of water resources.

490. Special Topics. Cr. var. Prerequisite: Permission of instructor. Literature reviews and conferences in accordance with needs and interests of the student.
courses in the following areas desirable: general and organic chemistry, biochemistry, general physics, statistics, calculus, and bacteriology. For students planning graduate study in zoology, two years of French, German, or Russian language are recommended.

Majors in the Department of Zoology and Entomology are encouraged to take advantage of the special opportunities available in summer courses at the Iowa State Lakeside Laboratory at Lake Okoboji. (See Index, Iowa Lakeside Laboratory.) Those students interested should consult with, or write to, the department chairman.

Graduate Study

The department offers work for the degrees Master of Science and Doctor of Philosophy with majors in entomology, fisheries biology, wildlife biology, and zoology. The student may specialize in animal behavior, biological control, cell biology, ecology, economic entomology, embryology (developmental biology), insect pathology, insect physiology, insect toxicology, limnology, medical entomology, morphol­ogy, parasitology, physiology, biology, protozoology, taxonomy, and toxicology. To determine the major appropriate to the specialization, refer to the list on file in the Department of Zoology and Entomology, or in the Graduate College.

Prerequisite to major and minor graduate work in the Department of Zoology and Entomology is the completion of at least two years of zoological courses, for part of which credit in other closely allied biological sciences may be substituted. Specific course requirements for advanced degrees depend partly upon previous training and experience in the major field of specialization.

Proficiency in one foreign language is required for the M.S. and Ph.D. The same language may serve for both degrees. The degree of proficiency may be demonstrated by one year of college credit with a minimal average of 2.0 (on a 4.0=A scale), by an Educational Testing Service Foreign Language Examination score of at least 500, or by committee approval of equivalent language experience. The student's committee may require additional language competence.

The department also participates in the interdepartmental programs in cell biology, immunology, and water resources (See Biology, Cell Biology, Immunology, or Water Resources.)

The Iowa Cooperative Fisheries Unit and the Iowa Cooperative Wildlife Research Unit are associated with the graduate programs in the Fisheries and Wildlife Biology section of the department. The European Corn Borer Laboratory at Ankeny is available for advanced study in certain phases of entomological research. Various graduate courses in zoology are taught during the summer, and special research projects are supervised at the Iowa Lakeside Laboratory, Lake Okoboji.

Open to graduate students for minor credit only:

307, 324, 401, 405, 428, 447, 448, 455, 464, 465. Index to field of work is given by the second and third figures of course numbers:

00-09 General Zoology. 50-59 Physiology.
10-19 Parasitology. 60-69 Fisheries Biology.
20-29 Anatomy. 70-79 Entomology.
30-39 Embryology. 90-99 Problems and Research.

Courses Primarily for Undergraduate Students


155. Introduction to Human Physiology and Anatomy. (3-4) Cr. 3. F.W.S.S. Prerequisite: Biol 161 or 102R. Basic physiology and anatomy of human organ systems.

165. Laboratory in Human Physiology and Anatomy. (0-6) Cr. 2. F.W.S.S. Prerequisite: Credit or classification in 155. Laboratory to accompany 155.


302L. Field Biology. (See list of courses offered at the Iowa Lakeside Laboratory.)

303. Biological Evolution. (Biol 303) See Biology.


311. Introduction to Parasitology. (3-3) Cr. 4. F.W. Prerequisite: 106, Biol 103. Ulmer. Survey of major groups of animal parasites; biology and host-parasite relationships of parasitic protozoans, worms, arachnids, crustaceans, insects, and vertebrates.

320. Comparative Chordate Anatomy. (3-6) Cr. & F.W. S.S.S. Prerequisite: 106. Ellis. Selected chordate types with emphasis on those not examined in general courses.

322. Chordate Histology. (3-6) Cr. 5. F.W.S. Prerequisite: 106; 320 recommended. Ellis. Microscopic study of chordate tissues.


326. Human Anatomy. (3-6) Cr. & F.S.S. Prerequisite: 106 or 154. Haupt. Human anatomy with comparisons to typical mammals. For students preparing for zoology and health-related fields.

327. Anatomy of Human Movement. (0-6) Cr. & F.W. Prerequisite: 106 or 154. Haupt. Human anatomy with emphasis on musculo-skeletal structures. For students majoring in physical education or wishing to fulfill requirements for secondary school coaching certification.

*340. Ornithology. (2-6) Cr. 4. S. Prerequisite: 200; Biol 103. Weller. Biology, classification, and identification of major bird groups; laboratory and field work, including one-day field trips to bird habitats.

*342. Principles of Wildlife Conservation. (3-0) Cr. 3. W. Prerequisite: 309. History and biological basis of fish and wildlife conservation and management.


358. Human Physiology. (3-3) Cr. 4. F. Prerequisite: 166. Dunham. Functions of human organ systems.

359. Human Prenatal Development. (3-3) Cr. 4. F.W.S. Prerequisite: 156 or Biol 101A. Fassell. Physiological aspects of intrauterine life; maternal-fetal relationships; reproductive hormones.


*371L Field Entomology. (See list of courses offered at the Iowa Lakeside Laboratory.)

*376. Applied Entomology. (For 376) (2-4) Cr. 4. W. Prerequisite: 106. Owens, Pedigo. Introduction to entomology and insect population management. The department recommends that credit in both 376 and 370 not be applied toward graduation.

401. Biological Illustration. (0-4) Cr. 2. W. Prerequisite: Fifteen credits in biological sciences. Haupt. Techniques and principles of biological illustration with emphasis on illustrating for scientific publications.

*405. Fundamentals of Limnology. (2-3) Cr. 3. S. Prerequisite: Fifteen credits in biological sciences or graduate classification. Bachmann. Physical and chemical features of inland waters and their biological communities. Techniques of limnological surveys. Field trips.


*448. Wildlife Techniques. (2-6) Cr. 4. S. Prerequisite: 340, 309, 447, Biol 424. Petersen. Survey and evaluation of techniques used in research and management of game animals; laboratory and field work, including extended trips.

455. Principles of Physiology. (3-5) Cr. 5. W.S.SSL. Prerequisite: 106; Chem 142, 142L; organic chemistry and physics recommended. Redmond. Introduction to systemic functions with emphasis on vertebrates.

465. Physiology of Reproduction. (3-0) Cr. 3. W.S. Prerequisite: 358, permission of instructor. Fassell. Study and discussion of current research in human reproductive physiology.


*484. Ichthyology. (2-6) Cr. 4. F.W. Prerequisite: 200; 320 recommended. Menzel. Biology, classification, and life histories of fishes. Field trips.

*485. Fisheries Management. (3-3) Cr. 4. F. Prerequisite: 405, 464. Carlander. Concepts and practices relating to maintenance and improvement of fishery resources. Lake and stream surveys for evaluations as fish habitat. Field trips.

490. Special Problems. (Biol 490) Cr. 1 to 5 each time taken. Prerequisite: Fifteen credits in zoology, permission of instructor.

E. Entomology.

F. Fisheries and Wildlife Biology.

Z. Zoology.

*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.


*502. Animal Ecology. (3-0) Cr. 3. W.S.SSL. Prerequisite: 309, 405; Bot 424. Wing. Ecosystem, community, population, and habitat ecology of animals.

503. Primate Evolution. (Anthr 503) (3-0) Cr. 3. S. Prerequisite: Ten credits in biological science; or Anthr 219 and three credits in biological science. Hicks, Shaw. Relationships and developmental history of primates.


508L, 509L Aquatic Ecology. (See list of courses offered at the Iowa Lakeside Laboratory.)

510L. Protozoology. (See list of courses offered at the Iowa Lakeside Laboratory.)


512. Helminthology. (2-6) Cr. 4. F. Prerequisite: 307, 320. Ulmer. Survey of the classification, trematodes, and nematodes parasitic in wildlife, laboratory animals, and man; selected vectors; identification, life histories, and host-parasite relationships. See also list of courses offered at the Iowa Lakeside Laboratory.

512L. Helminthology. (See list of courses offered at the Iowa Lakeside Laboratory.)


Courses for Graduate Students, major or minor

601. Zoological Literature. (3-0) Cr. 3. W. Prerequisite: Fifteen credits in zoology. Knight. Literature and classical authors of zoology and entomology; nomenclators; rules of zoological nomenclature.


605. Advanced Limnology. (3-6) Cr. 5. F. Prerequisite: 405. Bachmann. Physical, chemical, and biological processes of lakes and streams and their relationships to biological productivity, ecological succession, and water quality. Limnological research techniques. Field trips.

612. Advanced Parasitology. (3-0) Cr. 3. S. Prerequisite: 512; 511 recommended. Ulmer. Special phases in host-parasite relationships of parasitic protozoans, worms, and arthropods.


650. Cell Physiology. (3-0) Cr. 3 or S. Prerequisite: 428; B & B 405. Culture techniques, regulation of macromolecular synthesis and cell structure geneses during cell cycle.

654. Vertebrate Endocrinology. (3-0) Cr. 3. W. Prerequisite: 551 or 552 or 553. Griffith. Structure and function of endocrine systems of vertebrates.


656. Selected Topics in Insect Physiology. (3-0) Cr. 3. S. Prerequisite: 655. Nutchm. Advanced study of selected physiological processes of insects and review of current problems in insect physiology.


663. Fisheries Resources. (3-0) Cr. 3. Alt. W., offered 1975. Prerequisite: 465. Muncy. Survey of fishery resources; analysis of problems concerned with commercial and sport fisheries and their management.

671. Insect Ecology and Population Management. (3-3) Cr. 4. S. Prerequisite: 370, 402; Stat 101 or 401. Pedigo. Insect populations, emphasizing outbreaks, assessment, and concepts of management.


675. Insect Toxicology. (3-0) Cr. 3. Alt. S., offered 1974. Prerequisite: 572, and 650 or 655. Dahm. Chemistry and mode of action of modern insecticides.


699. Research.

E. Entomology.
F. Fisheries and Wildlife Biology.
Z. Zoology.

*Courses administered by the College of Agriculture. All others administered by the College of Sciences and Humanities.
**Courses Offered at the Iowa Lakeside Laboratory**

**302L Field Biology.** (4-12) Cr. 4. SSL Animals in the field, with particular emphasis on their recognition and on collecting, preserving, and laboratory culture methods. May not be used as a substitute prerequisite for advanced courses which list 108L as prerequisite. Field trips. Must be taken concurrently with Bot 301L.


**508L, 509L Aquatic Ecology.** (8-24) Cr. 8 each. SSL Survey of local aquatic organisms and aquatic habitats; analysis of physiographic, physical, and chemical factors. Emphasis on field work, methodology, and basic ecological principles. Field trips.

**510L Protozoology.** (8-24) Cr. 8. SSL Prerequisite: Fifteen credits in zoology; 307 or 311 recommended. Survey of the free-living and parasitic protozoans; evolution, identification, life cycles, and host-parasite relationships.

**512L Helminthology.** (8-24) Cr. 8. SSL Prerequisite: 307, 320. Survey of the cestodes, trematodes, and nematodes parasitic in wildlife, laboratory animals, and man; study of selected vectors; identification, life histories, and host-parasite relationships emphasized.

**590. Special Topics.** (See preceding section.)

**699. Research.**

*Courses administered by the College of Agriculture. All others administered by the College of Sciences and Humanities.*

**Written permission of the instructor is prerequisite to all courses offered at the Iowa Lakeside Laboratory. For current information concerning courses, registration, and housing, see the annual Iowa Lakeside Laboratory Bulletin. This bulletin is usually available from participating departments after February 15.*

---

**Summary of Degrees Conferred**

1872-1972

| Baccalaureate Degrees (total) | 3,050 | 3,207 | 65,026 |
| Present Curricula | 3,050 | 3,207 | 64,248 |
| Discontinued Curricula | — | — | 778 |
| Doctor of Veterinary Medicine (total) | 71 | 69 | 2,965 |
| Higher Degrees (total) | 972 | 807 | 16,752 |
| Doctor of Philosophy | 311 | 277 | 5,104 |
| Master of Engineering | 31 | 28 | 172 |
| Master of Landscape Architecture | 6 | 3 | 40 |
| Master of Science | 524 | 475 | 10,682 |
| Master of Education | 1 | — | 139 |
| Master of Architecture | 0 | 1 | 17 |
| Master of Arts | 28 | 22 | 60 |
| Master of Forestry | 0 | 1 | 5 |
| Professional Degrees | — | — | 354 |
| in Engineering | — | — | 58 |
| Master of Agriculture | — | — | 12 |
| Master of Forestry | — | — | 1 |
| Master of Landscape Architecture | — | — | 1 |
| Honorary Degrees | — | — | 10 |
| Doctor of Agriculture | — | — | 14 |
| Doctor of Engineering | — | — | 9 |
| Doctor of Laws | — | — | 51 |
| Doctor of Science | — | — | 24 |
| All Degrees Conferred | 4,093 | 4,083 | 84,743 |
## Summary of Enrollment

### ENROLLMENT 1970-71

A summary of different individuals enrolled during the year.

<table>
<thead>
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<th>Academic Year</th>
<th>Men</th>
<th>Women</th>
<th>Total</th>
<th>Fiscal Year</th>
<th>Men</th>
<th>Women</th>
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<td>16,032</td>
<td>7,524</td>
<td>23,556</td>
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<td><strong>II. Students not in residence of college grade: extension, off-campus</strong></td>
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<td>47</td>
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<td>101</td>
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<td>155</td>
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<tr>
<td><strong>III. Students in residence not of college grade: music, driver training and nursery school</strong></td>
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<td>126</td>
<td>213</td>
<td>120</td>
<td>158</td>
<td>278</td>
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### ENROLLMENT 1971-72

A summary of different individuals enrolled during the year.

<table>
<thead>
<tr>
<th>Academic Year</th>
<th>Men</th>
<th>Women</th>
<th>Total</th>
<th>Fiscal Year</th>
<th>Men</th>
<th>Women</th>
<th>Total</th>
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<td>Sept. 1971-</td>
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<td>7,214</td>
<td>21,696</td>
<td>June 1972</td>
<td>15,673</td>
<td>7,981</td>
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<td>June 1971-</td>
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<tr>
<td><strong>Grand total of all students</strong></td>
<td>14,482</td>
<td>7,214</td>
<td>21,696</td>
<td>15,673</td>
<td>7,981</td>
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<tr>
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<td>6,468</td>
<td>2,483</td>
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<td><strong>II. Students not in residence of college grade: extension, off-campus</strong></td>
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<td>111</td>
<td>297</td>
<td>233</td>
<td>120</td>
<td>353</td>
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</tr>
<tr>
<td><strong>III. Students in residence not of college grade: music, driver training and nursery school</strong></td>
<td>236</td>
<td>199</td>
<td>435</td>
<td>281</td>
<td>213</td>
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