1981

Graduate Catalog 1981-83, Iowa State University Bulletin

Iowa State University

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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 underway 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 in education in the liberal arts tradition.

This Iowa State University Bulletin is a general catalog of information regarding fees, curricula, and related policies and procedures. Every effort has been made to make the bulletin accurate as of the date of publication; however, all policies, procedures, fees, and charges are subject to change at any time by appropriate action of the faculty, the university administration, or the State Board of Regents.

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 1979-80 academic year more than 4,500 baccalaureate, advanced, and Doctor of Veterinary Medicine degrees were awarded.

Nondiscrimination and Affirmative Action Policy

Iowa State University reaffirms its commitment to comply with all applicable federal and state civil rights laws, regulations, and orders.

In keeping with this commitment, the University will ensure that all decisions pertinent to employment, conditions of employment, programs, activities, services and the use of facilities shall be rendered, with few exceptions, without regard to age, color, known handicaps (mental or physical), national origin, race, religion, sex, or status as a disabled veteran or veteran of the Vietnam era. Exceptions to this policy may be made in matters regarding bona fide occupational qualifications, business necessity, and to eliminate problems attendant to underutilization. Race, sex, or other such factors, when used for the purpose of reducing underutilization, must be only one of several factors considered in the selection of otherwise qualified personnel.

Further, the University will regard any act of sexual harassment which contains a threat or insinuation that the lack of sexual submission will adversely affect a person's employment, conditions of employment, academic standing, receipt of services, or other conditions which affect his or her livelihood as a violation of university policies subject to appropriate disciplinary action.

This policy applies to all university-sponsored programs and activities as well as those which are planned or conducted under the University's auspices.

Any person who believes that he or she has been the recipient of a discriminatory act prohibited by this policy may file a grievance with the University's Affirmative Action Office at 214 Beardshear. Retaliation against persons filing complaints for the redress of a grievance, or for assisting in an investigation pursuant to the filing of a complaint, shall be prohibited.
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
Mrs. H. Rand Petersen, President
R. Wayne Richey, Executive Secretary

Terms expire June 30, 1981
Ray V. Bailey ................. Clarion
Mrs. H. Rand Petersen .......... Harlan
Donald H. Shaw ............... Davenport

Terms expire June 30, 1983
Percy G. Harris, M.D. .......... Cedar Rapids
Peter J. Wenstrom ............ Essex

Terms expire June 30, 1985
S. J. Brownlee .............. Emmetsburg
Ann Jorgensen ............... Garrison
Arthur Neu .................. Carroll

Administration of Iowa State University

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James H. Hilton, D.Sc., President Emeritus
George C. Christensen, D.V.M., Ph.D., Vice President for Academic Affairs
Cari Hamilton, B.S., Vice President for Information and Development
Wayne R. Moore, B.S., Vice President for Business and Finance
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Lee R. Kolmer, Ph.D., Dean of the College of Agriculture
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Virgil S. Lagomarcino, Ph.D., Dean of the College of Education
David R. Boylan, Ph.D., Dean of the College of Engineering

Ruth E. Deacon, Ph.D., Dean of the College of Home Economics
Wallace A. Russell, Ph.D., Dean of the College of Sciences and Humanities
Phillip T. Pearson, D.V.M., Ph.D., Dean of the College of Veterinary Medicine
Robert S. Hansen, Ph.D., Director of the Ames Laboratory, U.S. Department of Energy
Charles E. Donhowe, M.S., Dean of University Extension
Fred C. Schlunz, M.S., Dean of Admissions and Records
Jon C. Dalton, Ed.D., Dean of Student Life
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Daniel J. Zaffarano, Vice President for Research and Dean
Norman L. Jacobson, Associate Vice President for Research and Associate Dean
George G. Karas, Associate Dean
Martin J. Ulmer, Associate Dean

The Graduate College at Iowa State University is responsible for the quality of graduate education, for administering students' graduate programs and for promoting research support from various governmental, industrial, and private agencies.

Members of the graduate faculty have a dual role of teaching and research. All courses offered for major or minor credit are taught by graduate faculty members. Through an advisory committee system, they supervise individual programs of study which are especially designed for each graduate student's needs.

The graduate faculty includes the president, the vice-president for academic affairs, the dean and associate deans of the Graduate College, deans and associate deans of the other seven colleges, the dean of library services, and the directors and associate directors of research institutes as full members. Executive officers of departments and other members of the General Faculty may be elected to associate or full 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 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 students result in knowledge necessary to help society solve problems in educational, scientific, technological, and socio-economic 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 Master of Arts and the Master of Science degrees 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 Agriculture, Master of Architecture, Master of Community and Regional Planning, Master of Education, Master of Engineering, Master of Landscape Architecture, Master of Public Administration, and Specialist are offered.

### Graduate Appointments
Graduate assistantships, 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 Research Institute for Studies in Education, the Engineering Research Institute, the Home Economics Research Institute, the Sciences and Humanities Research Institute, the Veterinary Medical Research Institute, the Statistical Laboratory, the Computers Center, the Energy and Mineral Research Institute, the Water Resources Research Institute, and the Office of the Vice President for Research.

A half-time graduate assistantship permits the holder to enroll for a maximum of 12 semester credits. Recipients of these assistantships are assessed fees at resident rates. Students who are graduates of a regionally accredited college or university in the United States or of a recognized institution in another country, whose requirements for the bachelor's degree are substantially equivalent to those of Iowa State University, who graduated in the highest quarter of their respective classes and who present the requisite undergraduate or graduate preparation, may apply for these appointments. 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 appropriate department head.

The satisfactory completion of one appointment, plus satisfactory academic performance, will ordinarily make a student eligible for reappointment. After a period of 5 years of full time study for the master's degree or 7 years for the doctorate, the student will not normally be continued on assistantship support.

Fellowships and traineeships offered by agencies of the federal government are sometimes available. Applicants for these awards must present evidence of superior scholarship. Further information may be secured by writing to the dean of the Graduate College.

### MASUA Traveling Scholar Program
As a member of the Mid-America States Universities Association, Iowa State University participates in the MASUA Traveling Scholar Program. Universities cooperating include Iowa State University, University of Kansas, Kansas State University, University of Missouri at Columbia, Kansas City, Rolla and St. Louis; University of Nebraska; University of Oklahoma; and Oklahoma State University.

The MASUA Traveling Scholar Program is designed to provide breadth and depth in the opportunities for graduate study offered at MASUA universities by permitting advanced graduate students to study at another MASUA university where they may utilize unique facilities or specializations.

Graduate students at MASUA universities are eligible to participate in this program for a minimum of one term of enrollment. The student's major adviser initiates the proposal for the student's participation by contacting the professor at another MASUA university where the student wishes to study. The graduate dean at each university involved must concur in proposed participation. During the time of participation, the student will register for research or special topics credit for the appropriate number of hours and pay fees at the home university. Graduate students chosen to participate in the program will be provided $100 for travel and a stipend of $50 monthly for a minimum of three months (payable from MASUA funds upon return to the home institution).

Additional information concerning the MASUA Traveling Scholarship Program is available at the Graduate Office.

### Postdoctoral Study
Opportunities are provided for postdoctoral study through the extensive research programs of the University. Inquiries should be directed to the appropriate department, 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, subject to the approval of the head of his or her department or section, may carry not more than 6 semester credits of graduate work per semester, provided such does not interfere with other duties. This privilege may be extended to members of the research, instructional, or extension staffs of the rank of assistant professor upon approval of the dean of the employee's college 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
Admission to the Graduate College may be granted to a graduate of an institution in the United States which is accredited by a recognized regional association or to a graduate of a recognized institution in another country whose requirements for the bachelor's degree are substantially equivalent to those of Iowa State University. For information concerning graduate study in a particular academic discipline, a prospective student is invited to correspond with the head of the department in which he or she wishes to study.
Application forms are available from the Office of Admissions, 7 Beardshear Hall. These forms, 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 semester in which the student wishes to matriculate. An application fee of $10 is charged each applicant formally applying for admission to the Graduate College. If the undergraduate degree is from Iowa State University or if the student is applying for nondegree admission, no application fee is assessed.

Graduate Record Examination. The Graduate Record Examination (GRE) is not a university-wide requirement for all applicants. However, some departments require or recommend submission of GRE scores; individual departmental statements appearing later in this catalog should be consulted for this information.

Full Admission. An applicant who is a graduate of a nationally accredited university in the United States or of a recognized university in another country whose requirements for the bachelor's degree are equivalent to those of Iowa State University, and who ranks in the upper one-half of his/her class, may be admitted to the Graduate College. Admission does not constitute acceptance as a candidate for a degree.

Provisional Admission. An applicant who is a graduate of a regionally accredited college or university in the United States or of a recognized university in another country, whose requirements for the bachelor's degree are substantially equivalent to those of Iowa State University, and who ranks in the upper one-half of his/her class, but who has certain background deficiencies to remedy, may be admitted to the Graduate College on provisional admission if recommended by the department and approved by the dean of the Graduate College. Students accepted on provisional admission are eligible to apply for graduate assistantships. Transfer from provisional admission to full admission requires recommendation of the major professor and approval by the Graduate College.

Restricted Admission may be granted to persons who are graduates of nationally accredited universities or colleges of the United States but who do not rank in the upper one-half of their class, and to graduates of recognized foreign institutions. This status requires the recommendation of the major department and approval of the dean of the Graduate College. Transfer from restricted to full admission usually requires completion of at least 10 semester hours of graduate level courses with a grade average of B or better. The recommendation must be submitted by the student's major professor and approved by the dean of the Graduate College.

Nondegree Admission. A graduate of a nationally accredited university or college in the United States may be granted nondegree admission: (1) to take course work for subsequent transfer to other institutions; (2) to enroll occasionally in off-campus graduate courses; or (3) to take graduate courses without pursuing an advanced degree program. Transfer from nondegree admission to full admission requires submission of complete academic records, recommendation by the department head and the approval of the graduate dean, and payment of an application fee of $10 by those who do not have an undergraduate degree from Iowa State University.

For those students admitted to the Graduate College for nondegree study, no more than 9 semester hours of graduate credit earned under the non-degree option may be applied if the student later chooses to undertake 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. New students will be sent a medical history form with their letter of admission. This form must be completed and on file at the Student Health Service before a student can be treated by a physician there. All records are confidential. Student records are not available without the student's permission. A copy of the record may be sent to a physician of the student's choice.

English Requirement. The status of all graduate students whose native language is English is determined at the time of admission. Students who fall into one of the following categories have fulfilled the English requirement: (1) have completed an undergraduate English composition sequence with a B average or better; (2) have passed, as an undergraduate, an English examination which tests the ability to communicate in writing (similar to the ISU Graduate English Examination); and 3) have written in the English language a master's thesis which has been accepted by a regionally accredited college or university; or 4) have passed the Graduate English Examination as specified by the major department. Individual departments may establish more stringent requirements. The departments of Chemistry, Earth Sciences, Physical Education and Veterinary Pathology require their students to satisfy the requirement by taking the Graduate English Examination.

Students (except those admitted on a nondegree basis) who are required to take the Graduate English Examination should do so before completing 12 credit hours of graduate work at Iowa State University.

Foreign Students. An applicant who is a graduate of a recognized foreign institution is subject to the same criteria for admission as a graduate from an institution in the United States and may be recommended for the same admission categories described above. The admission deadline for international students is one month prior to the first day of classes for each semester.

A graduate student whose native language is not English must take a special English placement examination administered by the Department of English in lieu of the standard qualifying examination.

Students registered on a restricted or nondegree admission basis and those placed on probation are not eligible for assistantship appointment.

Foreign students are required to carry adequate health and accident insurance while in residence.

Registration. Planning Graduate Study. Scholastic competence, independence and maturity of thought should have dominance over other objectives or 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 semester. Schedules for graduate assistants on one-half time appointments are limited to a maximum of 12 credits. For full-time staff members, the limit is 6 credits.

Even though course and residence requirements have been met graduate students must register in any semester in which the facilities of the institution or staff time are being used, including library borrowing privileges and preparation of thesis or dissertation, or preparation for examination. The student must be registered during the semester in which the preliminary and final examinations are held.

Interim Registration. Registration for special work between semesters and during certain vacation periods cannot exceed 1 credit for each week that the student is in residence.

"In Absentia" Registration. Graduate work by correspondence is not permitted nor is it accepted in transfer. In absenta registration is restricted to thesis preparation after completion of all course work for a 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 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.

Continuing Registration Policy. Graduate students who pass the oral preliminary examination for the Ph.D. degree and leave the Ames campus for one or more semesters before receiving their degrees must pay an "R" fee each semester for maintenance of their records each semester they are absent and are not using university facilities or faculty time. This fee must be continued each semester excluding summer.

Students who have passed the preliminary oral examination and are using university facilities and/or faculty time must register each semester for an appropriate number of credit hours and must pay resident or nonresident fees, in accordance with their residency status, regardless of whether or not they are 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 the credit hours of the course.
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 degrees Master of Science or Doctor of Philosophy and Doctor of Veterinary Medicine.

To participate in such a concurrent program, a student 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.

Degree Requirements
A Graduate Student Handbook is available in the Graduate Office. Each new graduate student is urged to obtain a copy. A Graduate Faculty Handbook, listing policies and procedures of the Graduate College, is also available to all staff members and may be obtained at the Graduate Office.

Probation. To remain in good standing, a student must maintain an average of B on all work taken in the Graduate College (exclusive of research credits). A student may be placed on probation for failure to meet scholastic 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 second semester 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 five years. A student beginning a Ph.D. degree program at Iowa State with a master's degree is expected to complete the Ph.D. within five years, while a student beginning a Ph.D. degree program without the master's degree is expected to complete the program within seven years. In special circumstances the student's advisory committee may recommend that the graduate dean extend these degree time limits.

Cases in which the student leaves Iowa State during his or her graduate career and later returns are dealt with individually by the student's advisory committee and the Graduate Office.

Master of Science and Master of Arts
A student on full admission becomes eligible for candidacy after completing one semester's work with a B average. General requirements for the degree are as follows:

Appointment of the Student's Advisory Committee. As soon as practicable after the student enrolls in the Graduate College, 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 be from a department other than that in which the student is enrolled. At least one member of the committee should be a full member of the graduate faculty. An associate member of the graduate faculty may serve as a 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 one of the departments represented in the joint appointment.

Program of Study. A program of study, developed by the student and major professor in consultation with the program of study committee, should be submitted for approval by the end of the second semester in residence.

Residence. There is no on-campus residence requirement for the master's degree.

Credits. At least 30 credits of acceptable graduate work must be completed, not less than 22 of which must be earned from this institution.

At least 20 of the credits must be in the field of emphasis of the student's major. Credits earned in courses numbered 500 or above may also be applied toward the degree. Any transfer of credits from another institution must be approved by the student's major professor and the dean of the Graduate College. Graduate credit will be approved for transfer only if it is of B grade or better.

Major. The exact number of credits in a 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 department to another without written permission from the heads of departments involved, and approval of the dean of the Graduate College.

Foreign Languages. There is no uniform language requirement for the Graduate College. Please see the departmental descriptions in this catalog for specific departmental requirements.

For those departments wishing to utilize them and for students interested in transferring a foreign language, 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 substitute for the reading knowledge of one foreign language. This option will apply only when specifically recommended by the student's program of study committee.

The foreign language requirements, where applicable, must be met before the semester in which the student will receive the degree.

Application for Graduation. Application for graduation must be made by midterm of the semester preceding the semester 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, 213 Beardshear Hall. These copies of the thesis must be deposited not less than two weeks prior to commencement. A charge of $3.00 will be made to cover library costs and title publication in Iowa State Journal of Research.

The student should consult The Graduate College Thesis Manual for instructions about thesis preparation and time schedules.

Final Examination. After all other requirements have been met, the final examination shall be taken over all graduate work, including the thesis were applicable. It will be oral, but may be written in part if specified by the committee in charge.

Graduation Approval Slip. This slip is prepared by the Office of Student Records about two weeks before the end of the semester. Candidates wishing to secure this form at any earlier date should file a request with the Graduate Office at least three days prior to the time the form is needed.

Master of Science and Master of Arts — Nonthesis
In certain departments a nonthesis degree program may be undertaken. This will require satisfactory completion of at least 30 credit hours of acceptable work (not including research credit) and satisfactory completion of a comprehensive examination. Every nonthesis master's program, however, must present substantial evidence of individual accomplishment which may vary from a special report, for example, or an annotated bibliography to a project of research, design, or other creative endeavor. A minimum of three hours of such independent work is required on every program of study for a nonthesis master's degree. This element of creative independent study shall be explicitly identified on the program of study. Detailed requirements may vary with fields. Reference should be made to the departmental descriptions in this catalog.

Master of Agriculture
The major in professional agriculture is an off-campus, non-thesis program leading to the degree Master of Agriculture. It is available to students wishing to pursue graduate study in agriculture without taking formal course work on campus. The program is considered to be a terminal master's degree. Students are required to take a minimum of two courses in each of three disciplines and complete 24 semester credits of formal course work. Courses are offered in Agricultural Management, Agronomy, Animal Science, and Economics. A minimum of four credits of creative component experience is required. Four workshops of one credit each are also required.

Master of Architecture
The Department of Architecture offers several programs leading to the degree Master of Architecture, a professional degree. Beyond the degree Bachelor of Architecture, a minimum of 30 graduate credits is required. Beyond the degrees B.A. or B.S. in architecture or environmental design, a minimum of 60 credits is required. For students completing both baccalaureate degrees, a program of more than 60 credits will be tailored to each student's experience, training, and education. For programs of 60 credits or more, 40 of these credits must be graduate credits.

Master of Community and Regional Planning
The degree Master of Community and Regional Planning requires 52 semester hour credits, including a 9 credit thesis.

Graduate Courses Taken by Seniors. Certain graduate level courses listed in the General Catalog may be taken for graduate credit by undergraduate seniors at Iowa State University.
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 9 semester 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 for the bachelor’s degree.

Master of Education
For the degree master of education, a minimum of 30 credits of graduate level courses will be required. A creative component is required in which the student demonstrates an ability to perform creative, independent study.

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 offered to meet the needs for professionally oriented programs on campus, and for off-campus professionally oriented programs at locations with adequate library and laboratory facilities. An appropriate number of credit hours in design, laboratory work, computation or independent study is required as evidence of individual accomplishment.

Of the minimum credit requirement of 30, 22 credits must be received from Iowa State University.

Master of Landscape Architecture
The degree Master of Landscape Architecture requires a minimum of 40 graduate credits and the satisfactory completion of a thesis or a terminal project.

Master of Public Administration
This is a professional degree program designed to provide training necessary for an administrator in a public or quasi-public bureaucracy. A minimum of 39 semester credit hours is required in six subject areas. Either an internship in a governmental unit or a thesis is required.

Specialist
This degree is a post-master’s degree in school psychology requiring 60 hours of work beyond the baccalaureate. It requires a thesis equivalent to a master’s thesis, and an internship in the public schools of not less than 600 clock hours.

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 or her chosen field, (2) development of a dissertation which is a significant contribution to knowledge and which shows 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 Program of Study Committee. As soon as practical after the student enrolls in the Graduate College, the department head or chair 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 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 major department. A faculty member holding a joint appointment may not serve as an “outside the department” member on a committee even if one such member is to be selected from the faculty of another department. The selected representatives from the joint appointment. An associate member of the graduate faculty may not serve as a major professor of a doctoral program but may co-chair a doctoral committee.

Program of Study. A program of study should be developed by the student in consultation with his or her major professor and committee. This should be submitted for approval by the end of the second semester in residence.

Residence. A minimum of 72 graduate credits must be earned for a Ph.D. degree. At least 36 credits including all dissertation research credits must be earned under the supervision of the student’s program of study committee. Graduate credits of B grade or better earned at another institution may be transferred at the discretion of the program of study committee and the approval of the department and Graduate College. Transfer of S and “pass” grades may be accepted for research only when such grades can be documented as being B grade or better. Responsibility for submitting such documentation to the Graduate College rests with the student’s program of study committee.

At least 24 credits must be earned during two consecutive semesters while in residence at the University.

Major and Minor. A major is the area of study or academic concentration 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.

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 12 hours of applicable graduate credit as required by the student’s committee.

Opportunities also exist for majoring in more than one area of study (co-major or joint-major programs).

Courses for minor credit are 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. The Graduate College has no uniform requirements. Foreign language requirements for those departments having them are specified in the individual department descriptions in the Courses and Programs section of the catalog.

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 substitute for the reading knowledge of one foreign language. This option will apply only when specifically recommended by the student’s program of study 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 commencement, two complete and approved copies of the dissertation shall be deposited with the Thesis Office, 213 Beardshear Hall.

At the same time the dissertation is deposited, two typed 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, 213 Beardshear. A charge of $60 will be made to cover costs, microfilming of the dissertation, and publication of a 600-word abstract in Dissertation Abstracts. The abstract should cover the entire dissertation and should 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, it 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 semester. 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.
### Summary of Graduate Degrees, Majors and Areas of Specialization

<table>
<thead>
<tr>
<th>Aerospace Engineering</th>
<th>M.Eng., M.S., Ph.D.</th>
<th>Aerospace Engineering.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agricultural Education</td>
<td>M.S., Ph.D.</td>
<td>Agricultural Education.</td>
</tr>
<tr>
<td>Anthropology</td>
<td>See Sociology.</td>
<td></td>
</tr>
<tr>
<td>Architecture</td>
<td>M. Arch.</td>
<td>Architecture.</td>
</tr>
<tr>
<td>Biochemistry and Biophysics</td>
<td>M.S., Ph.D.</td>
<td>Biochemistry, Biophysics.</td>
</tr>
<tr>
<td>Biomedical Engineering (Interdepartmental Program)</td>
<td>M.S., Ph.D.</td>
<td>Biomedical Engineering.</td>
</tr>
<tr>
<td>Botany</td>
<td>M.S., Ph.D.</td>
<td>Botany, Aquatic Plant Biology, Cytology, Ecology, Economic Botany, Morphology, Mycology, Physiology, Taxonomy.</td>
</tr>
<tr>
<td>Chemical Engineering</td>
<td>M. Eng., M.S., Ph.D.</td>
<td>Chemical Engineering.</td>
</tr>
<tr>
<td>Chemistry</td>
<td>M.S., Ph.D.</td>
<td>Analytical Chemistry, Chemistry, Inorganic-Organic (Ph.D. only), Physical-Inorganic (Ph.D. only), Analytical-Physical, Organic-Analytical (Ph.D. only), Inorganic Chemistry (Ph.D. only), Organic Chemistry, Physical Chemistry.</td>
</tr>
<tr>
<td>Child Development</td>
<td>M.S., Ph.D.</td>
<td>Child Development.</td>
</tr>
<tr>
<td>Civil Engineering</td>
<td>M.S., Ph.D.</td>
<td>Civil Engineering (M.S. only), Geodesy and Photogrammetry (M.S. only), Municipal Engineering (M.S. only), Sanitary Engineering, Geotechnical Engineering, Structural Engineering, Transportation Engineering.</td>
</tr>
<tr>
<td>Community and Regional Planning</td>
<td>M.C.R.P.</td>
<td>Community and Regional Planning.</td>
</tr>
<tr>
<td>Computer Science</td>
<td>M.S., Ph.D.</td>
<td>Computer Science.</td>
</tr>
<tr>
<td>Earth Sciences</td>
<td>M.S., Ph.D.</td>
<td>Earth Science, Geology, Meteorology.</td>
</tr>
<tr>
<td>Economics</td>
<td>M.S., Ph.D.</td>
<td>Agricultural Economics, Economics.</td>
</tr>
<tr>
<td>Education</td>
<td>See Professional Studies.</td>
<td></td>
</tr>
<tr>
<td>Electrical Engineering</td>
<td>M.Eng., M.S., Ph.D.</td>
<td>Electrical Engineering, Electromagnetics (Ph.D. only), Computer Engineering (Ph.D. only), Control Systems (Ph.D. only), Electric Power (Ph.D. only).</td>
</tr>
<tr>
<td>Energy Systems Engineering</td>
<td>Interdepartmental minor only.</td>
<td></td>
</tr>
<tr>
<td>English</td>
<td>M.A.</td>
<td>English.</td>
</tr>
<tr>
<td>Entomology</td>
<td>M.S., Ph.D.</td>
<td>Entomology, Behavior, Biological Control, Ecology, Economic Entomology, Medical Entomology, Host Plant Resistance, Morphology, Pathology, Pest Management, Physiology, Systematics, Insecticide Toxicology.</td>
</tr>
<tr>
<td>Family Environment</td>
<td>M.S., Ph.D. (joint major)</td>
<td>Family Environment.</td>
</tr>
<tr>
<td>Food and Nutrition</td>
<td>M.S., Ph.D.</td>
<td>Food and Nutrition (M.S. only), Food Science, Nutrition.</td>
</tr>
<tr>
<td>Food Technology</td>
<td>M.S., Ph.D.</td>
<td>Food Technology, Meat Science (joint major).</td>
</tr>
<tr>
<td>Forestry</td>
<td>M.S., Ph.D.</td>
<td>Forestry, Administration and Management (M.S. only), Biology (M.S. only), Biometry, Economics and Marketing (M.S. only), Wood Science (M.S. only), Forest Economics (Ph.D. only), Biology - Wood Science (Ph.D. only).</td>
</tr>
<tr>
<td>General Graduate Studies (Interdepartmental Program)</td>
<td>M.A., M.S.</td>
<td>General Graduate Studies, Arts and Humanities, Biological Sciences, International Development Studies, Physical Sciences, Social Sciences.</td>
</tr>
<tr>
<td>Genetics</td>
<td>M.S., Ph.D.</td>
<td>Genetics.</td>
</tr>
<tr>
<td>Gerontology</td>
<td>Interdepartmental minor only.</td>
<td></td>
</tr>
<tr>
<td>History</td>
<td>M.A., Ph.D.</td>
<td>History (M.A. only), History of Technology and Science.</td>
</tr>
<tr>
<td>Home Economics Education</td>
<td>M.Ed., M.S., Ph.D.</td>
<td>Home Economics Education.</td>
</tr>
<tr>
<td>Horticulture</td>
<td>M.S., Ph.D.</td>
<td>Horticulture.</td>
</tr>
<tr>
<td>Housing</td>
<td>Interdepartmental minor only.</td>
<td></td>
</tr>
<tr>
<td>Immunobiology (Interdepartmental Program)</td>
<td>M.S., Ph.D.</td>
<td>Immunobiology.</td>
</tr>
<tr>
<td>Industrial Administrative Sciences (Interdepartmental Program)</td>
<td>M.S.</td>
<td>Industrial Administrative Sciences.</td>
</tr>
<tr>
<td>Industrial Engineering</td>
<td>M.Eng., M.S., Ph.D.</td>
<td>Engineering Valuation, Industrial Engineering (M.Eng., M.S. only), Operations Research (co-specialization, M.S. only).</td>
</tr>
<tr>
<td>Industrial Relations (Interdepartmental Program)</td>
<td>M.S.</td>
<td>Industrial Relations.</td>
</tr>
<tr>
<td>Institution Management</td>
<td>M.S., Ph.D. (joint major)</td>
<td>Institution Management.</td>
</tr>
<tr>
<td>Journalism and Mass Communication</td>
<td>M.S.</td>
<td>Journalism and Mass Communication.</td>
</tr>
<tr>
<td>Landscape Architecture</td>
<td>M.L.A.</td>
<td>Landscape Architecture.</td>
</tr>
<tr>
<td>Mathematics</td>
<td>M.S., Ph.D.</td>
<td>Applied Mathematics, Mathematics.</td>
</tr>
<tr>
<td>Mechanical Engineering</td>
<td>M.S., Ph.D.</td>
<td>Applied Mechanical Engineering.</td>
</tr>
<tr>
<td>Microbiology</td>
<td>M.S., Ph.D.</td>
<td>Microbiology, Applied, Food, Medical, Systematic Microbiology; Immunology; Microbial Ecology, Genetics, Morphology, Physiology, Virology.</td>
</tr>
<tr>
<td>Molecular, Cellular, and Developmental Biology</td>
<td>Interdepartmental major only</td>
<td></td>
</tr>
</tbody>
</table>

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*Areas of specialization are shown in italics.
Nuclear Engineering — M. Eng., M.S., Ph.D., Nuclear Engineering.
Physical Education — M.S. — Physical Education.
Plant Pathology, Seed and Weed Sciences — M.S., Ph.D. — Plant Pathology, Seed Science, Weed Science.
Political Science — M.A., M.P.A. — Political Science, Public Administration.
Professional Agriculture (Interdepartmental Program) — M.Ag., Professional Agriculture.
Professional Studies in Education — M.Ed., M.S., Ph.D. — Education; Adult and Extension Education; Curriculum and Instructional Media; Educational Administration; Elementary Education (M.S. only); Counselor Education; Higher Education; History, Philosophy, and Comparative Education; Learning Disabilities (M.S. only); Research and Evaluation.
Psychology — M.S., Ph.D. — Psychology, School Psychology (Sp. only).
Sociology and Anthropology — M.A., M.S., Ph.D. — Rural Sociology, Sociology, Anthropology (M.A. only).

Veterinary Microbiology and Preventive Medicine — M.S., Ph.D. — Veterinary Microbiology, Veterinary Preventive Medicine (M.S. only).

Veterinary Pathology — M.S., Ph.D. — Veterinary Pathology, Veterinary Parasitology, Veterinary Toxicology.
Veterinary Physiology and Pharmacology — M.S., Ph.D. — Veterinary Physiology, Pharmacology.
Water Resources — Interdepartmental major only.
Zoology — M.S., Ph.D. — Zoology; Animal Behavior, Cellular Biology, Comparative Physiology, Ecology, Endocrinology, Immunobiology, Cellular, Molecular and Developmental Biology, Neurobiology, Physiology.

Interdepartmental Minors

Interdepartmental Offerings and Cooperating Departments

Interdepartmental Programs
Biomedical Engineering — College of Engineering, College of Veterinary Medicine.
General Graduate Studies — all departments offering graduate courses.
Immunobiology — Agronomy, Animal Science, Biochemistry and Biophysics, Food and Nutrition, Genetics, Microbiology, Veterinary Microbiology and Preventive Medicine, Veterinary Pathology, and Zoology.
Industrial Administrative Sciences — Business Administration, Economics, Industrial Engineering, Statistics.
Industrial Relations — Economics, Industrial Engineering, Political Science, Psychology, Sociology.
Professional Agriculture — Agricultural Engineering, Agronomy, Animal Science, Economics.

Interdepartmental Majors
Molecular, Cellular, and Developmental Biology — Agronomy, Animal Science, Biochemistry and Biophysics, Botany, Food Technology, Genetics, Microbiology, and Zoology.
Transportation Planning — Business Administration, Civil Engineering, Community and Regional Planning, Economics, Industrial Engineering, Political Science, and Sociology.

Housing — Architecture, Art and Design, Community and Regional Planning, Family Environment, Landscape Architecture.
Fees and Expenses

(Fees and tuition are subject to change without notice.)

A registration fee is charged all students of the University. A full registration fee covers most laboratory fees, access to student health facilities, use of the Library, membership in the Memorial Union, and a number of student activities. In certain courses involving special expenses, an additional fee may be charged. These fees are indicated in the course description of the specific courses involved. Students who are not residents of Iowa pay an additional tuition fee each semester. This tuition fee is assessed in accordance with regulations of the State Board of Regents which are found in the General Catalog under Admission and Records.

All fees and expenses listed in this catalog are effective as of fall semester 1981. They are subject to change without notice.

Fee Schedule

<table>
<thead>
<tr>
<th>Per Semester</th>
<th>Resident</th>
<th>Nonresident</th>
</tr>
</thead>
<tbody>
<tr>
<td>Graduate</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(9 or more hours)</td>
<td>$540</td>
<td>$1243</td>
</tr>
</tbody>
</table>

Fees for students enrolled for less than a full course load are given below. There is a minimum 2-hour fee for all students. Audits and zero credit courses are assessed on contact hours and there is a maximum charge for zero credit courses of 3 hours. R credits are assessed as one credit only if no other credits are taken. The continuing registration fee for graduate students is $80. If the total number of credits includes .5 credit, such as 6.5, fees are assessed as the next larger whole number of credits. Therefore 6.5 credit hours would be assessed as 7 credit hours.

Summer session fees are charged per credit hour as indicated in the hourly fee schedule, except that nonresidence students taking 2 hours or less are assessed at the resident rate.

<table>
<thead>
<tr>
<th>Hourly Fee Schedule</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of Hour</td>
</tr>
<tr>
<td>1</td>
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<td>2</td>
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<tr>
<td>3</td>
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<tr>
<td>9</td>
</tr>
</tbody>
</table>

*Nonresident students taking 4 hours or less fall and spring and 2 hours or less summer are assessed at the resident rate.

Private Music Instruction

University students, per semester
1 lesson per week, ½ hour  $50
1 lesson per week, 1 hour $80

Nonuniversity students, per semester
1 lesson per week, ½ hour $90
1 lesson per week, 1 hour $160

Special Students and Noncollegiate Students

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

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 Fee

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.

Reinstatement Fee

Students receiving college approval to be reinstated after having been dropped for nonpayment of fees must pay a $10 reinstatement fee in addition to all other fees due.

Activity Fee

The activity fee for undergraduates and graduate students taking courses on campus is included in the general registration fee. Fees for courses taken off campus do not include the activity fee. Off-campus students may pay $25 per semester which allows them to pay student admission rates to concerts, lectures, debates, and athletic events.

Fee Refund for Cancellation of Registration

For those who withdraw during the first week, a 100 percent refund will be made. For those who withdraw after the first week, 80 percent will be retained and the remainder refunded according to the following schedule:

- 75 percent if withdrawal is during the second week.
- 50 percent if withdrawal is during the third week.
- 25 percent if withdrawal is during the fourth week.

No refund for a withdrawal after the end of the fourth week.

Fee refund for students who drop into light classification or reduce overload:

- 90 percent if change is made during first week.
- 75 percent if change is made during second week.
- 50 percent if change is made during third week.
- 25 percent if change is made during fourth week.

No refund after the fourth week.

For the refund policy for off campus courses, contact the Office of Continuing Education.

Change of Classification Fee

Starting the 6th day of classes a $5 fee is charged for course drops, additions, and section changes. Changes approved by the classification office at the same time are charged a single fee.

Workshops on Campus

Graduate and undergraduate students enrolled in 1-credit workshops on campus pay $80 tuition.

Off Campus Fees

For off-campus fees, contact the Office of Continuing Education.
Graduate Student Housing

Graduate Residence Hall

Buchanan Hall provides housing in 174 single occupancy rooms and 108 double occupancy rooms for single graduate students and single adult undergraduate students. A suite-type room plan provides a semiprivate bath shared by the occupants of two single rooms or two double rooms. Public areas include a lounge, television room, recreation area, vending room, laundry room, and administration office.

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

The room rate as of June 1980 was $714 per academic year in a double room, or $939 per academic year in a single room. A meal ticket may be purchased (for $861 per academic year as of June 1980) to eat in a residence hall dining room.

Single Student Apartments

There are 105 two-bedroom apartments in Schilletter Village designated for use by single students. The rate for these apartments as of July 1980 was $279 per month per apartment. Each apartment normally houses 4 students.

The apartments are furnished with the same furniture used in the undergraduate residence hall rooms plus range and refrigerator. Water service and trash removal are included in the rent. Students pay their own gas, electricity, and telephone.

There are also 150 one bedroom apartments in Pammel Court designated for use by single students. Pammel Court units are furnished with range, refrigerator, drapes, bunk beds and mattresses. Water service and trash removal are included in the $30.00 (July 1980) a month rental rate. Students pay their own gas, electricity and telephone. Each apartment houses two single students.

Family Apartments

The University provides 155 apartments in Schilletter Village, 500 apartments in University Village, 196 apartments in Hawthorn Court, and 370 apartments in Pammel Court for student families. Rates for these apartments as of July 1, 1980 were $174 per month for Schilletter Village, $159.50 per month for University Village, $148 per month for Hawthorn Court, and $65-$70 per month for Pammel Court. Apartments are unfurnished except for ranges and refrigerators, which are provided in all but Pammel Court.

Family apartments in Pammel Court have ranges but not refrigerators. Water service and garbage removal are included in the rental. Residents pay for their own gas, electricity, and telephone.

Approximately 40% of Iowa State's student families live in university apartments. The remainder find accommodations in private homes, apartments, and trailer courts in and near Ames or commute from surrounding communities.

A list of off-campus apartments for student families may be seen at the University Student Apartment Office; however, the majority of the available rentals may be obtained from local newspapers and real estate offices.

Applications for University Student Apartments will be accepted not more than one year in advance of attending the University.

Assignments are made by date of application.

Address correspondence concerning student apartments to the Director of University Student Apartments, 100 University Village, 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 in older houses and apartments may 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 and apartments. Other housing may be obtained through real estate agents, local newspapers, or by contacting individuals.

It is best that the student come to Ames well in advance of the time he or she 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 requirements of the individual.

The single occupancy room-rental rates average $25 per week; the double occupancy room rental rates average $20 per person per week. The student usually furnishes bed linens, towels, and study lamp. Average rental rate per student sharing an apartment or house would be in the $75 to $85 range per month. Board for students living in off-campus rooms may be obtained in residence hall dining rooms, private restaurants, or the Memorial Union.

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 $53 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 personnel is presented here. 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, Ph.D., Director
John P. Mahlstede, Ph.D., Associate Director
Ruth E. Deacon, Ph.D., Assistant Director
Thamon E. Hazen, Ph.D., Assistant Director
Ronald C. Powers, Ph.D., Assistant Director

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

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

Currently, research is being conducted in:
- agricultural bacteriology
- agricultural economics, agricultural education, agricultural engineering, agricultural journalism, agricultural statistics, agronomy, animal science, animal ecology, biochemistry, entomology, fisheries and wildlife biology, food technology, forestry, genetics, home economics, horticulture, plant pathology, seed and weed science, and sociology.

Ames Laboratory of the United States Department of Energy

Robert S. Hansen, Ph.D., Director
Veilma A. Fassell, Ph.D., Deputy Director
Eugene Catus, D.S., Associate Director
William J. Kerans, Ph.D., Associate Director
Kenneth L. Kliewer, Ph.D., Associate Director
Adolf F. Voigt, Ph.D., Assistant Director

Because of the outstanding record of achievement of the Iowa State project in atomic energy during the war years, the Atomic Energy Commission decided to continue this program of research in the nuclear and other energy-related fields at Iowa State University in the postwar period. Accordingly, it established on the campus one of its major research centers, known as the Ames Laboratory of the Atomic Energy Commission. This laboratory specializes in the basic research necessary to the development and utilization of energy resources of the country. On October 11, 1974 a federal legislative act abolished the Atomic Energy Commission and created the Energy Research and Development Administration which in turn was abolished with the establishment of the cabinet-level U.S. Department of Energy on October 1, 1977.

The University has leased areas on the campus to DOE for the location of Spedding Hall, the Metallurgy, and Metals Development buildings, and the former research reactor building. The Laboratory also provides research opportunities for more than one hundred and fifty graduate students and part-time work for a number of advanced undergraduate students.

The Laboratory's major research effort is in the basic sciences, and aims at providing the foundation for future energy technologies. Particular emphasis is directed at preparing new materials, whose chemical properties are characterized, evaluated and interpreted. Applied work builds on the Laboratory's strength in the basic sciences and includes programs in superconductors, environmental science, solar cells, and materials resistant to the severe environments found in energy conversion processes.

Center for Agricultural and Rural Development

Earl O. Heady, Ph.D., Director

The Center is a research organization concerned especially with the economic, social, political, and administrative problems related to the rapidly changing structure of agriculture, rural communities and the environment. Its work emphasizes that portion of the population outside metropolitan areas and the interrelationship of rural areas with urban problems. It develops and applies large-scale models relating to the economic structure of the agricultural sector.

The Center research program focuses on equity problems which accompany rapid national economic growth and the speeding technological transformation of agriculture. It conducts research aimed at measuring and explaining disparities in income, employment, welfare, and environmental conditions for residents of nonmetropolitan America as compared to those of urban centers. Analysis is also devoted to private and public means by which these disparities can be overcome and how the resources of rural areas can be used most effectively for national benefit and protection of environmental quality.

The broad complex of problems relating to income and welfare of people in agriculture and rural communities and the best use of resources in rural areas involves research at local, state, and national levels. Also, in integrating U.S. policies with international development and food aid possibilities, the Center maintains international projects in rural community and agricultural development. It is concerned with general policy of food production and agricultural income at both domestic and world levels.

Computation Center

Clair G. Maple, D.Sc., Director
Dale D. Grosvenor, Ph.D., Associate Director
Robert J. Lambert, Ph.D., Associate Director
George O. Strawn, Ph.D., Associate Director
Michael D. Bowman, M.S., Assistant to the Director
George F. Covert, M.S., Assistant Director
Systems
John B. Linderblood, Assistant Director
Operations
Jerome Niebaum, Ph.D., Assistant Director
Interactive Computing

The first digital computer to incorporate the concept of a memory was developed at Iowa State in the late 1930s by J. V. Attanasoff and his graduate student Clifford E. Berry, and was considered to be operational in 1940. This was just one, albeit an important one, of several events that have taken place on our campus in the last sixty years which led to the organization of the Computation Center in 1962 as a University-wide computing service and a centralized facility for research and education in the computing sciences.

University students, faculty and staff members having computational problems may use the computing service as well as the consulting services. The Center maintains a variety of computing facilities ranging from personal computers through large-scale digital and analog computers. Peripheral equipment is available to transfer data from punched paper tape, standard and mini-flexible diskettes and digital cassettes to other secondary storage devices compatible with the central computers. Remote job entry stations, linear in several buildings around the campus and interactive terminals are available in clusters and individually at widely dispersed locations including the dormitories. An emphasis on interactive graphics has recently been added.

The ability to control experiments in the laboratory, gather data and forward it to the central facilities for processing and have the results returned to the laboratory is available over the high speed datanet. The Center offers non credit short courses in computer programming and related topics and provides liaison for academic departments offering formal courses using the computer. Research encompasses numerical analysis, mathematics, programming research, digital computer systems, and computer assisted instruction. Standardized programs and systems have been developed and acquired to support a wide range of applied research areas. These widely used packages include many of the common statistical packages, linear programming, selective dissemination of
information, solution of linear algebraic systems of equations, eigenvalue problems, simulation, and graphics support.

Energy and Mineral Resources Research Institute

Robert S. Hansen, Ph.D., Director
Velmer A. Fassel, Ph.D., Deputy Director
Eugene Catus, B.S., Associate Director
William J. Kernan, Ph.D., Associate Director
Kenneth L. Kiiewer, Ph.D., Associate Director
Adolf F. Vogt, Ph.D., Assistant Director

During World War II, a small group of scientists and coworkers at Iowa State played a very important role in the atomic energy program. Through their efforts, a process was developed and demonstrated for making high purity uranium metal. Before the process was turned over to industry, more than 2 million pounds of uranium metal were produced on campus in a temporary building. Shortly after World War II, Major General Leslie R. Groves presented the Ames project employees with the Army-Navy “E” award for excellence in industrial production of a vital war material.

In order that the program of the University in this field might be carried forward in peacetime, the Iowa State University Institute for Atomic Research was authorized by the Iowa State Board of Regents on Nov. 1, 1945. The name of the Institute was changed to the Energy and Mineral Resources Research Institute in 1974. The Institute coordinates and administers fundamental energy research programs. Specifically, its purposes are:

- To administer Iowa State University’s contract with the U.S. Department of Energy for the operation of the Ames Laboratory.
- To build and maintain a strong group of scientists working in the fundamental phases of physics and chemistry as they apply to energy conversion processes, and to develop the applied science aspects of physics, chemistry, metallurgy, and engineering.
- To make available on campus a group of experts in current energy technologies who may be consulted by faculty who wish to apply these new tools to their own problems.
- To encourage voluntary cooperation and coordination of this type of research on the campus. Particular emphasis is placed on sharing information when it is needed from several different scientific fields.
- To implement research enabling graduate students to obtain the specialized knowledge they will need to do independent research in their fields. Formal course work is offered and degrees are awarded through several departments and colleges.

Engineering Research Institute

D. R. Boylan, Dean and Director

The Engineering Research Institute (ERI) was organized in 1904 as the research arm of the College of Engineering. ERI coordinates research involving all engineering academic departments.

Senior research personnel of ERI are also active in teaching. The major portion of the research activity is related to graduate instruction and training. Research projects are generally initiated and supervised by the staff. Research is funded by state appropriations and by industrial and government grants and contracts.

Major research programs include studies in: process chemistry, ceramic materials, electrical power systems, enzymic processes, computers, solid-state devices, gas dynamics, fluid mechanics, highway materials, turbomachinery, sanitary engineering, soils, structures, water resources, fluid power, coal processing, heat flow, alternate energy systems, microwave propagation, agricultural products utilization, tornado dynamics, wind effects, holography, biomedical engineering, transportation engineering, structural dynamics, and computational aerodynamics.

Facilities include aerodynamic shock tubes, low- and high-speed wind tunnels, chemical process pilot plants, x-ray and infrared spectrometers, microprobe analyzer, transmission and scanning electron microscopes, analog and digital computers, and nuclear reactor.

Technical service groups include machine shops, electronic shops, analytic laboratory, equipment inventory, editorial and technical illustrating service.

Home Economics Research Institute

Ruth Deacon, Ph.D., Director
Mary E. Heltsley, Ph.D., Associate Director

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

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

Research is conducted in the fields of child development, family environment, food and nutrition, home economics education, institution management, and textiles and clothing.

Industrial Relations Center

Paul M. Muchinsky, Ph.D., Director

Concern over the profound impact of economic and social change in a dynamic economy led to the establishment of an Industrial Relations Center at Iowa State University by the Board of Regents in June 1966.

The Center’s primary focus is on interdisciplinary research to increase our knowledge about the behavior of both individuals and organizations in the employment relationship. Faculty members associated with the Center come principally from the disciplines of economics, educational administration, accounting, political science, psychology, and sociology. Through an interdisciplinary Graduate College faculty committee the Center administers an M.S. degree program in industrial relations.

The research is cathodic in nature, reflecting the broad spectrum of the field of industrial relations as a discipline and also the diverse interests of some 20 Iowa State faculty members currently active in the Center’s research and teaching programs. Research currently in progress includes employee selection and placement studies, quantitative behavioral research in manpower economics, and empirical research on public policy issues affecting industrial relations.

As an interdisciplinary entity embracing faculty from several different disciplines and three colleges, the Center is funded primarily by the University. The Center also obtains funding from specific grants and contracts from private and governmental sources.

North Central Regional Center for Rural Development

Ronald C. Powers, Ph.D., Director

The Center is a research and extension organization supported by the land grant universities of the North Central Region and the U.S. Department of Agriculture. Its purpose is to develop and implement research and extension programs in rural development for states in the region. This purpose is attained through research by faculty at Iowa State University and cooperative projects with personnel of other land grant universities in the region. The Center also assists in extension programs through the development of materials and the training of rural development personnel in the region. A major activity of Center personnel, in cooperation with specialists and administrators of other universities, is to develop systematic and coordinated research and extension programs related to major problems of rural development in the North Central Region. The Center is governed by a Board of Directors representing the land grant universities in the region, USDA and the Farm Foundation. Advice to the Center is provided by representatives of several regional research and extension committees.

The Center sponsors conferences and workshops cooperatively with the universities in the region and with other regional centers. These conferences are developed as a means of bringing together current knowledge about such rural development problems as industrialization; community services, housing, quality of life, and processes of rural development.

Nutritional Sciences Council

Jerry W. Young, Ph.D.

The Nutritional Sciences Council consists of faculty members and qualified collaborators who are engaged in research, extension, or teaching in the nutritional sciences and closely related disciplines. Membership is by election. The Council develops symposia on topics of international interest, sponsors an interdepartmental seminar, “Modern Views of Nutrition,” and arranges short courses designed to fill specific needs in the total nutrition program. It promotes evaluation and coordination of teaching and research programs in the nutritional sciences. The governing body is a seven-member advisory committee elected from the membership of the Council.

Physiology Council

Neal R. Cholvin, D.V.M., Ph.D.
J. D. Blaustein, Zoology, August 31, 1983; N. R. Cholvin, Biomedical Engineering, August 31, 1981; C. D. Drewes, Zoology, August 31, 1981; R. L. Engen, Veterinary Physiology and Pharmacology, August 31, 1982; S. P. Ford,
Research activities are directly concerned with, but not limited to, teacher education in the major areas of elementary, secondary, graduate, and continuing education. Research is conducted in areas of specialization such as: adult education, agricultural education, educational administration, elementary education, secondary education, higher education, home economics education, curriculum and instruction, guidance and counseling, industrial education, philosophy of education, vocational-technical education, and areas cognate to the College of Education's commitment to the preparation of educational personnel.

The research programs are implemented through research activities of institute staff, faculty, and graduate students. In engaging in research the Institute cooperates with other colleges and research institutes within the University and other universities in the state, with schools, school districts, area schools, the Iowa State Department of Public Instruction, other state departments of education, regional educational research centers, national research centers, and various agencies of the federal government. By special arrangement, certain facilities and equipment may be made available by the Veterinary Medical Research Institute, National Animal Disease Center, and the Iowa State Energy and Mineral Resources Research Institute.

The Physiology Council consists of interested faculty members who are engaged in research and instruction in physiology and closely related areas. The Council encourages cooperation between departments and promotes development and coordination of unique and interdisciplinary programs, seminars, and symposia of interest to physiologists.

Various aspects of graduate study and research in physiology are supervised in the following departments: Animal Ecology, Animal Science, Biomedical Engineering, Botany, Entomology, Food and Nutrition, Veterinary Physiology and Pharmacology, and Zoology. Co-majors in these departments are possible. In addition, training and research in certain aspects of applied physiology are supervised in the following departments: Agronomy, Biochemistry and Biophysics, Forestry, Genetics, Horticulture, Microbiology, Physical Education, Veterinary Microbiology and Preventive Medicine, and Veterinary Pathology.

The Institute of Social Sciences and Humanities Research Institute

Wallace A. Russell, Ph.D., Director
Thomas W. Turnage, Ph.D., Associate Director

Research programs in the College of Sciences and Humanities are sponsored, coordinated, and administered through the Sciences and Humanities Research Institute. Its primary objective is to encourage basic research and creative scholarship in the five major areas included in the college—the humanities, the social sciences, the biological sciences, the physical sciences, and the mathematical disciplines. These activities are carried out, with support from the Institute, by faculty members of the college and by graduate students working in these areas. In addition, the Institute works closely with other research agencies, both on campus and off, and administers externally funded sponsored research within the college.

In extending the frontiers of knowledge, these activities contribute directly to the University's educational mission. In addition, they provide ideas and results which may aid in the solution of both present and future problems of the state and the nation.

The Soil Science Institute

Wayne H. Scholtes, Ph.D., Director

The Soil Science Institute is a multidisciplinary institute with the objective of conducting instruction of most current information in the subject matter areas supportive to the field of soil genesis and classification. Since its inception at ISU in 1966, it has been offered every other year for selected soil scientists from the U.S. Department of Agriculture.

The Institute includes 10 cooperative staff members specializing in the instruction of climatology, crop physiology, statistics, geophysics, soil chemistry, soil classification, soil engineering, soil fertility, soil genesis, and soil physics.

Statistical Laboratory

Herbert A. David, Ph.D., Director

The Statistical Laboratory is a research and service institute which conducts research in statistical theory and methodology. It promotes and fosters the use of sound statistical methods in university research through on-campus consulting. Established in 1933, it was the first statistical center of its kind in the United States. The Laboratory cooperates closely with research workers in all colleges of the University. Staff and facilities are maintained for statistical consultation, statistical analysis and data processing, sample survey operations, and statistical design and analysis of surveys and experiments. Similar consulting aid, research cooperation, and services are extended to off-campus groups, other colleges and universities, and civic groups when such activities are of mutual benefit or otherwise in the public interest.

Veterinary Medical Diagnostic Laboratory

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

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

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

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

The modern physical plant of the laboratory is equipped with diagnostic and analytical facilities and instrumentation used in microbiological, chemical, toxicological, and pathological examination.

Veterinary Medical Research Institute

Phillip T. Pearson, D.V.M., Ph.D., Director
Melvin S. Hofer, D.V.M., Ph.D., Professor in Charge

The Veterinary Medical Research Institute has a multidisciplinary faculty with a responsibility to conduct research and offer research training in animal diseases. Research and research
training are conducted in the areas of viral, bacterial and parasitic diseases, immunology and basic biology.

The Veterinary Medical Research Institute occupies land adjacent to the new College of Veterinary Medicine at the southeast edge of the campus. It has a complement of research laboratories and animal isolation units.

The Institute includes 10 professional faculty members with specialized training in the fields of parasitology, epidemiology, microbiology, pathology, physiology, and biochemistry, and their supporting staff.

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

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

**Water Resources Research Institute**

Merwin D. Dougall, Ph.D., Director
Daniel J. Zaffarano, Ph.D., Administrative Coordinator

The Iowa State Water Resources Research Institute was established in 1964 as the designated state organization to accept funds and administer the state-federal water resources research program of the U.S. Department of Interior. Coordination is maintained with the Office of Water Research and Technology, U.S. Department of Interior, and with regional organizations of the water institutes in the Missouri River basin and the Upper Mississippi River basin, in carrying out the responsibilities of this interdisciplinary program.

The purpose of the program is to assist in solving water problems in Iowa, the Midwest, and the nation. Identifying research needs, conducting research, training students, and disseminating information and the results of research through technology transfer and extension are major objectives. The Institute operates under the guidance of the ISWRI Council, composed of seven faculty members at Iowa State University and four at the University of Iowa. These members represent a broad cross-section of the water-related disciplines in the sciences, humanities, and engineering phases of education, research, and extension. A research advisory board composed of technical representatives of state and federal water agencies assists the Institute in carrying out its program. Faculty members participating in the program represent many disciplines in the scientific-engineering-social-economic-legal-institutional framework within which the water resources of the nation are developed for beneficial use.

The Institute sponsors research projects on a broad variety of subjects. Proposals usually originate with the faculty, using OWRT and ISWRI guidelines and priorities. Support of graduate students at the master's and the Ph.D. level is emphasized so that students develop the specialized knowledge and skills necessary for continuing in these water-related fields.

Several specific problem areas of water resources have been outlined, and a research team approach has been implemented for identifying additional research needs and for conducting the required research. Close coordination is also maintained with research groups at other colleges and universities in Iowa.

The Institute sponsors conferences, symposia, and workshops and publishes the results of research and all symposia. It is closely associated with the multidisciplinary water resources graduate program at Iowa State and the comparable program at the University of Iowa.

**World Food Institute**

Charlotte Roderick, Ph.D., Director

The World Food Institute of Iowa State University was officially established in 1972 by the Iowa Board of Regents to focus Iowa State University's competencies and leadership upon the provision of adequate and nutritious food supplies for the world's peoples through research and education. The World Food Institute's five major goals are: (1) to analyze food and nutrition problems; (2) to generate solutions to food and nutrition problems and to suggest means for implementation of solutions; (3) to build competencies in people for the generation and implementation of solutions of food and nutrition problems; (4) to collect, analyze, and disseminate information bearing on food and nutrition problems; and (5) to study interrelationships between the United States, with particular emphasis on Iowa, and other countries of the world.

General policy decisions concerning the Institute are made by the Faculty Policy Committee. Members of the Faculty Policy Committee are appointed by the Vice President for Academic Affairs and are selected from among recommendations made by the deans of Iowa State University's colleges through the World Food Institute director. The Faculty Policy Committee is subdivided into three study areas—research, education, and extension. Problem areas are defined in these areas and the Faculty Policy Committee may recommend the establishment of a task force by the World Food Institute director.

Faculty members who have a research project, education activity, or extension program relating to world food problems are encouraged to contact the director of the Institute. The project will be evaluated, and if accepted will be classified as: Contributing Project — A project funded entirely by the World Food Institute or by agencies through the World Food Institute; Affiliated Project — A project jointly funded by the World Food Institute and a college, department, experiment station, or other institute on campus; Auxiliary Project — A project funded entirely by a college, department, experiment station, or other institute but which, because of emphasis on food problems, may be listed as a World Food Institute project.

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**University Extension**

Charles E. Donhowe, 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 extension units.

Cooperative Extension Service in Agriculture and Home Economics — Charles E. Donhowe, 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 non-credit 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) — David H. Swanson, director. An advisory service to Iowa industry and business. The center facilitates the dissemination of counsel and assistance in solving the operational problems of industry and business in the private sector.

Office of Continuing Education — 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.
Courses and Programs

Information About Courses

Course Numbers
The courses in each department are numbered from 1 to 699, according to the following groups:
1-99 — Courses not carrying credit toward a 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.

Credits and Contact Hours
The academic value of each course is stated in semester credits. Each credit is earned by attending one (50-minute) hour of lecture or recitation per week for the entire semester, or by attending a laboratory or studio period of two or three hours per week. In addition, undergraduate students typically will be expected to spend two hours in preparation outside of class for each lecture or recitation hour; additional outside work may be required for laboratory or studio classes.

Each course states the number of semester credits assigned to the course, preceded in parentheses by the number of hours in class (contact hours) expected of the student. The first of the two contact-hour numbers indicates the number of lecture or recitation class hours per week for the semester. The second is the number of laboratory or studio hours required per week.

The term "Cr. arr." means the amount of credit is arranged in advance between the student and the instructor. The credit to be earned depends on the amount of work expected of the student, in accordance with the policy that some combination of teacher-student contact and outside work by the student involving at least three hours per week for the entire semester is required for each credit.

The term "Cr. R." means that the course is required in a certain curriculum, but no credit is given.

Semester of Offering
Within each course description may be found one or more of the following letters: F, S, SS, indicating which term — fall, spring, summer session — of the academic year the course is offered. "Alt." is the abbreviation for alternate. The abbreviation "Yr." is used to designate a sequence of two courses taught fall and spring, respectively. If there is sufficient demand, courses may be offered more frequently than announced.

Course Prerequisite
A prerequisite indicates the specific academic background, or general academic maturity, considered necessary for the student to be ready to undertake the course. Prerequisites are usually stated in terms of specific courses, but equivalent preparation is usually acceptable. An instructor may, however, direct a student whose background does not meet the stated prerequisite, or its equivalent, to drop the course. Conversely, an instructor may waive the prerequisite for a course for which he or she is responsible. Thus, permission of the instructor is understood to be an alternate to the stated prerequisites in all courses.

Designators
For a list of abbreviations designating departments and programs, see page 16.

Graduate Programs

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.

Designators

Acct Accounting
Agr Agricultural Engineering
A Ecl Animal Ecology
Ad Ed Adult and Extension Education
Aer E Aerospace Engineering
AFAS Air Force Aerospace Studies
Ag Ed Agricultural Education
Ag M Agricultural Mechanization
Ag St Agricultural Studies
Agron Agronomy
Am In American Indian Studies

An S Animal Science
Anth Anthro Anthropology
Arch Architecture
Art Art and Design
Astr Astron Astronomy and Astrophysics
Ath Athletics
B B Biochemistry and Biophysics
B M E Biomedical Engineering
Biol Biology
Bot Botany
BusAd Business Administration
C D Child Development
C E Civ Engineering
C Grk Classical Greek
Ch E Chemical Engineering
Chem Chemistry
CI St Classical Studies
Co Ed Counselor Education
Com Sci Computer Science
Con E Construction Engineering
Cpr E Computer Engineering
C R P Community and Regional Planning
Curr Curriculum and Instructional Media
Dance Dance
Des S Design Studies
EE E Electrical Engineering
E M Engineering Mechanics
E Op Engineering Operations
E Sci Engineering Science
Ea Sc Earth Science
Econ Economics
EdAdm Educational Administration
El Ed Elementary Education
Engl English
Ent Entomology
Env S Environmental Studies
F E Family Environment
Fin Finance
F Lng Foreign Languages and Literatures
F N Food and Nutrition
F Tch Food Technology
For Forestry
F r E Freshman Engineering
Frnch French
G P S Geodesy, Photogrammetry, and Surveying
Gen Genetics
Geog Geography
Geol Geology
Ger German
Gr St General Graduate Studies
H Ed Home Economics Education
HE St Home Economics Studies
H P C Historical, Philosophical, and Comparative Studies in Education
H S Health Studies
Hg Ed Higher Education
Hist History
Hort Horticulture
Hous Housing
I A S Industrial Administrative Sciences
I E Industrial Engineering
I Ed Industrial Education
Mgt Institution Management
I R Industrial Relations
Imbio Immunobiology
Aerospace Engineering

Lennox N. Wilson, Acting Head of Department

The Graduate Faculty

Members: Anderson, Hsu, Iversen, McDaniel, Peterson, Pierson, Tannehill, Vogel, Wilson

Associate Members: James, Severiske, Vogel

The department offers work for the degrees Master of Engineering, Master of Science, and Doctor of Philosophy with major in aerospace engineering, and minor work to students taking major work in other departments. For all graduate degrees, it is possible to establish a co-major program with another graduate degree granting department. Within the aerospace department, work is available in the following areas: computational aerodynamics, optimization, atmospheric and tornado sciences, control systems, atmospheric and space flight mechanics, structural analysis, gasdynamics, turbulence, combustion, and swirling flow.

The major work for the degrees Master of Science and Doctor of Philosophy requires an acceptable thesis in addition to the course work. For the degree Master of Engineering, a comprehensive paper or suitable project as evidence of independent accomplishment is required. Appropriate credit is allotted for this requirement.

Minor work for aerospace engineering majors is usually selected from mathematics, physics, electrical engineering, engineering mechanics, mechanical engineering, and meteorology.

The normal prerequisite to major graduate work in aerospace engineering is the completion of a curriculum substantially equivalent to that required of aerospace engineering students at this University. However, because of the diversity of interests within the graduate programs in aerospace engineering, a student whose prior undergraduate or graduate education has been in allied engineering and/or scientific fields may also qualify. In such cases, it may be necessary for the student to take additional work to provide the requisite background in a chosen area of interest. A prospective graduate student is urged to specify the degree program and the specific field(s) of interest on the application for admission.

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 semester provided there is sufficient demand.

The department also participates in the interdepartmental programs of Energy Systems Engineering, and Technology and Social Change. (See Index.)

Courses for Graduate Students, minor only

321. Flight Structures Analysis. (3-0) Cr. 3. S. Prereq: E M 324, M S E 371. Determination of flight loads, materials selection for flight applications. Analysis of flight structures in unsymmetric bending, bending of two-material beams, torsion, shear flow due to bending and torsion in thin-walled structures, elastic instabilities.

341. Aerodynamic Theory I. (3-0) Cr. 3. F. Prereq: Math 266. Incompressible potential flow, Euler's equations, thin airfoil and finite wing theory.

342. Aerodynamic Theory II. (3-0) Cr. 3. S. Prereq: 341, M E 330 or 331. Energy equation, compressible flow, shock and expansion waves, linearized subsonic and supersonic flow, transonic flow, hypersonic flow.

351. Astrodynamics I. (3-0) Cr. 3. F. Prereq: Math 265, E M 345. Introduction to astrodynamics, two-body motion, coordinate systems, launch vehicle trajectories, and atmospheric entry trajectories. Orbital transfer methods, lunar and interplanetary trajectories.


442. VSTOL Aerodynamics and Performance. (3-0) Cr. 3. S. Prereq: 341, 355. Introduction to the aerodynamics, performance, stability, control and critical maneuvering characteristics of aerospace vehicles such as VSTOL aircraft, helicopters, hovercraft, and other short-range transportation vehicles.


461. Design and Analysis I. (1-6) Cr. 3. F. Prereq: Senior classification. Application of the principles and methods of analysis and synthesis in the solution of aerospace engineering design problems with emphasis on aircraft design.

462. Design and Analysis II. (1-6) Cr. 3. S. Prereq: 461. Preliminary design of aerospace vehicles. Detail design of aerospace vehicle components. Fundamental principles used in engineering development of aircraft, missile, and space systems.

464. Spacecraft Systems Engineering (3-0) Cr. 3. S. Prereq: 461, Phys 222, E E 441. Space environment, spacecraft, launch vehicle integration, placement in orbit, attitude control systems, attitude sensing systems, space communications, space power, thermal control, structures and mechanisms, scientific instruments.

485. Introduction to Hyperspace Engineering. (3-0) Cr. 3. S. Prereq: 341, 355, Phys 222. Introduction to elementary hyperspace vehicle performance, stability and control.

Courses Primarily for Graduate Students, major or minor

521. Airframe Analysis. (3-0) Cr. 3. F. Prereq: 421. Analysis of static and dynamic stresses and deformations in continuous aircraft structures. Approximate and numerical analysis of static and dynamic stresses and deformations in airframe design by normal mode technique.


533. Thermodynamics of Compressible Flow II. (M E 533) See Mechanical Engineering.

534. Experimental Gas Dynamics. (M E 534) See Mechanical Engineering.

541, 542. Advanced Aerosdynamics I, II. (3-0) Cr. 3 each. Yr. Prereq: 541: 341 or ME 424; 542: 541. Classical flow theory, compressible fluid theories, shock wave studies, and applications to aerodynamic shapes.

543. Advanced Aerosdynamics III. (3-0) Cr. 3. F. Prereq: 542. Applications of classical flow theory, compressible fluid theories, and shock theory to aerodynamic shapes.

544. Applied Wing Theory. (3-0) Cr. 3. F. Prereq: Credit or classification in 541 or 541. Introduction to finite difference methods used in modern engineering. Solution of example problems in fluid mechanics and heat transfer. 547: Application of computational methods to current problems in fluid mechanics and heat transfer.


552. Entry Dynamics. (3-0) Cr. 3. S. Prereq: 551. Atmospheric entry and entry dynamics of missiles and spacecraft. Trajectory control. Descent and landing. Thermal protection considerations. Entry vehicle attitude control.


571. Environmental Aerodynamics. (3-0) Cr. 3. Arranged. Prereq: 341. Survey of atmospheric turbulence, turbulent diffusion, and velocity profile within the atmospheric boundary layer with emphasis on modeling by means of the environmental wind tunnel.

575. Tornado Fluid Mechanics. (3-0) Cr. 3. As arranged. Prereq: 341. Formation of atmospheric vortices with the earth's surface, laboratory modeling of tornado vortices.

580. Special Topics. Cr. 1 to 5.

A. Aerodynamics
B. Propulsion
C. Stress Analysis
D. Flight Mechanics
E. Flight and Space Systems
F. Magnetofluidodynamics
G. Hyperspace
H. Viscous Aerodynamics
I. Design
J. Hypersonic Testing
K. Model Towing Basin Testing
L. Hypervelocity Testing
M. Computational Aerodynamics
N. Severe Storm Technology
O. Optimization

Courses for Graduate Students, major or minor

621. Aerodynamics Structures Analysis. (3-0) Cr. 3. S. Prereq: 521. The application of transfer matrix techniques to the analysis of various types of large aerospace structures under static, dynamic, and buckling loads.

625. Advanced Aeroelasticity II. (3-0) Cr. 3. As arranged. Prereq: 525. Aerodynamic and structural instabilities of fixed and rotating wing flight vehicles under discrete and random dynamic loads.


645, 646. Magnetofluidodynamics I, II. (3-0) Cr. 3 each. As arranged. Prereq: 645: 542; 646: 645. Electromagnetic theory, equations of motion for viscous, heat and electrically conducting fluids of multiple species, wave motions, engineering problems in magnetohydrodynamics and magnetogasodynamics.

647, 648. Dynamics of Real Gases I, II. (3-0) Cr. 3 each. As arranged. Prereq: 647: 542; 648: 647. Introduction of quantum theory and statistical mechanics to thermally and calorically imperfect gases, theories of harmonic and anharmonic oscillators, vibrational relaxing and chemically reacting flows behind a strong shock and through an expansion nozzle. Gasdynamic lasers.

650. Fluid Mechanics Seminar. (E E 650, M E 650) (1-0 to 5) Cr. 3 each time taken. Prereq: Permission of instructor. Special topics of current research interest to students and staff of departments concerned.

651, 652. Mechanics of Space Vehciles Maneuvers I, II. (3-0) Cr. 3 each. As arranged. Prereq: 651: 551; 652: 651. Vehicle orbital transfers, intercept and rendezvous problems, spacecraft and satellite attitude control using active and passive methods and vehicle entry control.

690. Advanced Topics. Cr. 1 to 5.

A. Aerodynamic Gasdynamics
B. Propulsion
C. Stress Analysis
D. Flight Mechanics
E. Flight and Space Systems
F. Magnetofluidodynamics
G. Hyperspace
H. Viscous Aerodynamics
I. Design
J. Creative Component
K. Computational Aerodynamics

699. Research.
Agricultural Education

Harold R. Crawford, Head of Department

The Graduate Faculty

Members: Bundy (Emeritus), Crawford, Kahler, Williams

Associate Members: Carter, Hoerner, Lawrence

The department offers work for the degrees Master of Science and Doctor of Philosophy with major in agriculture and minor work to students taking major work in other departments. Candidates pursuing the Master of Science degree may do so by completing either a thesis or nonthesis program of study. Complete descriptions of these programs are available in the department.

The department cooperates with other departments in the College of Agriculture to offer work for a co-major Master of Science degree to prepare area school and community college agriculture teachers.

Prerequisite to major graduate work in agricultural education is preparation substantially equivalent to the completion of the undergraduate curriculum in agricultural education or agricultural extension education offered at Iowa State University and adequate proof that the student ranks above average in scholastic ability and promise of vocational competence.

Off-campus courses are offered for professional personnel in the field. Three-week courses and workshops are offered during the summer sessions.

Courses Primarily for Graduate Students, major or minor, open to qualified undergraduates

500. Short Course in Agricultural Education. Cr. 1. Prereq: Permission of instructor. Specific problems, issues, and content areas in agricultural education. On and off campus on arranged basis.

511. Instructional and Organizational Problems of Beginning Teachers of Agricultural Education. (0-0) Cr. 1. F.S. Prereq: 417. Problems in instructional planning and methodology and in organizing the secondary, post-secondary, FFA, and agricultural experience programs.


590. Special Topics in Agricultural Education. Cr. 1-3. Prereq: 12 credits in agricultural education.

A. Curriculum
B. Methods
C. Philosophy
D. Evaluation
E. Administration
F. Leadership
G. Guidance

593. Workshop in Agricultural Education. Cr. 1-3 SS. Prereq: 12 credits in agricultural education.

A. Curriculum
B. Methods
C. C. Evaluation
D. Administration
E. Leadership
F. Guidance

599. Creative Component. For nonthesis M.S. degree program.

Courses for Graduate Students, major or minor


615. Seminar in Agricultural Education. (1-0) Cr. 1 F.S.

617. Professional Development of Teacher Educators in Agricultural Education. (1-0) Cr. 1. F. Prereq: Permission of instructor. Analysis of the roles and activities of teacher educators in agricultural education with emphasis on identifying and describing future personal roles in higher education.

620. Research Procedures in Agricultural Education. (3-0) Cr. 3. Alt. S. 1982; SS. 1983. Prereq: 9 credits in agricultural education and statistics. Application of research methods to agricultural education research. Identification of research priorities, selection and development of research design, and critique of research in agricultural education.

625. Administration and Supervision of Agricultural Education Programs. (3-0) Cr. 3 Alt. F. offered 1982. Prereq: 520. Management principles and practices of planning, organizing, directing, staffing and evaluating as applied to administration and supervision of programs in agricultural education.


699. Research.

Agricultural Engineering

Howard P. Johnson, Acting Head of Department

The Graduate Faculty

Members: Beer, Beresford (Emeritus), Buchele, Giese, Hazen, H. P. Johnson, Lalffen, Marley, Morford (Emeritus), R. J. Smith

Associate Members: C. Anderson, Baker, Bern, Bundy, Erbach, Hoerner, Kline, Soderholm

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, agricultural power and machinery, electric power and processing, and agricultural structures and environment.

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. However, because of the diversity of interests within the graduate programs in agricultural engineering, a student may qualify for graduate study even though the undergraduate training has been in a discipline other than engineering. Supporting work will be required depending on the student's background and area of interest with requirements defined by departmental guidelines.

For the degree Doctor of Philosophy the foreign language requirement, or a substitute, may be satisfied in one of three ways: (1) Demonstrate a communication competence (ETS score of 600 or 6 credit hours of 200 level) in one foreign language approved by the program-of-study committee. (2) Demonstrate a proficiency in FORTRAN computer language by course work (6 hours above Com S 172) or special examination. (3) Complete a minimum of 6 credits of additional course work not directly related to the major or minors. These courses are intended for the cultural enrichment of the student and are subject to the approval of the program of study committee.

The department also participates in the interdepartmental minor program in Energy Systems Engineering and in the interdepartmental programs in Technology and Social Change and Water Resources (see Index).

Courses for Graduate Students, minor only


444. Agricultural Machinery Design II. (0-6) Cr. 2. S. Prereq: 202, C.1, C.2. Control systems for field trips. Controls. Cr. 3. F. Prereq: C.1, C.2. Controls. Cr. 3. F.


Courses Primarily for Graduate Students, major or minor, open to qualified undergraduates

501. Agricultural Resources Engineering. (3-0) Cr. 3. F. Prereq: One 400 level A E course. Role of the engineer in agricultural resource development. Land and water resources development and conservation in agricultural technology. Research priorities, evaluation and support. Literature searches and project development.


590. Special Topics. Cr. 1 to 3. B. Mechanization


Courses for Graduate Students, major or minor


661. 662. Seminar. (1-0) Cr. 1. each. Yr. Discussion of research problems, methods, procedures, and reports. 690. Advanced Topics. Cr. var.


Agricultural Mechanization

Administered by the Department of Agricultural Engineering

H. P. Johnson, Professor in Charge

The Department of Agricultural Engineering offers courses for minor graduate credit in agricultural mechanization for students taking major work in other departments.

Courses for Graduate Students, major only

424. Drainage and Irrigation Management. (3-0) Cr. 3. S. Prereq: 324. Development of knowledge in drainage and irrigation on agricultural lands, interaction of agencies involved, and relationships to water use and control in agricultural production. Fee for field trip.


440. Intermediate Technology. (1-3) Cr. 2. S. Prereq: 9 credits of agricultural sciences. The philosophy and use of intermediate technology in developing countries. Developmental, planners, plans, and specifications of equipment. Case studies of appropriate technology.


574. Livestock Housing Systems. (2-0) Cr. 2. Offered as requested. Prereq: 6 credits of agricultural or biological science. Properties of most air, effects of environment on animal performance, principles of environmental control, feed handling systems, manure management alternatives, planning total systems. Designed for Master of Agriculture Program.


488. Teaching Agricultural Mechanics. (2-4) 8 weeks. Cr. 2. F. Prereq: 250, 255. Organization and management of the agricultural mechanics instructional program, facility and equipment. Students plan and present demonstrations of teaching agricultural mechanics skills.


Agronomy

John Pesek, Head of Department

The Graduate Faculty


Associate Members: Beller, Blackmer, Crossbie, Cruse, Fenton, George, Loychans, Miller, Mullen, Smith, Take, S. E. Taylor, Troeh, Vaughan, Voss, Whigham

The department offers work for the degrees of Master of Science and Doctor of Philosophy, with majors in crop production and physiology, plant breeding and cytogenetics, soil physics, soil chemistry, soil fertility, soil microbiology and biochemistry, soil morphogenesis and genesis, soil management, and agricultural climatology. Minor work is provided for students with majors in other departments. An M.S. nonthesis option is available for students desiring to pursue a special project not involving thesis research.
The M.S. nonthesis requirement is completion of 34 hours of graduate credit, which must include 4 hours of creative component (Agron 599), submission and approval of a report on the special project undertaken, and satisfactory completion of a final oral examination.

The department also cooperates in the interdepartmental programs of Immunobiology; Molecular, Developmental Biology; Technology and Social Change; and Water Resources (See Index.)

Prerequisite to major work in this department is completion of an undergraduate degree program with emphasis on biological and physical sciences. The foreign language requirement, if any, for the Ph.D. degree is established on an individual basis by the advisory committee appointed to guide the work of the student.

Courses for Graduate Students, minor only

318. Principles of Crop Physiology. (3-0) Cr. 3. F. S. Prereq: Bot 310 or 320. Pearce. Basic principles concerning the growth, development, and production of crop communities in relation to their environment.


485. Soil Biology. (Micro 485). (2-3) Cr. 3. F. Prereq: 154, Micro 300. Loyachan. Description of organisms in the soil and plant environment, and their role in organic matter decomposition (e.g., man-made chemicals and wastes), nitrogen fixation and transformations, and other processes which directly or indirectly affect people.

Courses Primarily for Graduate Students, major or minor, open to qualified undergraduates

500. Orientation Seminar. (2-0) Cr. F. Prereq: Graduate classification in agronomy, and from foreign country. Pesek and staff. An introduction to Iowa and U.S. agriculture for international scholars. Field trips when possible. Departmental and college research, teaching, and extension in fulfilling the charge given the land-grant University.


516. Crop Physiology and Management. (2-0 or 3-0) Cr. 2 or 3. S. Prereq: Bot 320. Shibles. Anderson. Physiology of crop growth, development, and reproductive processes, and ecological principles to crop culture and management. Students may elect physiology only (10 wks, 2 cr.) or the full topic (15 wks, 3 cr.)


529. Cyto genetics in Plant Breeding. (2-0) Cr. 3. Alt. F., offered 1981. Prereq: 521; Gen 501, 625. Peterson. Chromosome recombination, principles of chromosome pairing, gene distribution within the genome, abberations, poliploids, genome relations, aneuploids, nullisomic analysis, interspecific hybrids, cell fusion, evolution of the nucleotide, repetitive DNA, the eukaryotic genome, and emerging techniques for the genetic improvement of crops.


542. Advanced Crop Management. (2-0) Cr. 2. Off campus, offered as requested. Prereq: 318 or 412. Staff. Basic concepts in plant-soil-climate relationships with emphasis on recent advances in crop culture and management. Designed for the master of agriculture program.


556. Laboratory Methods in Soil Chemistry. (2-3) Cr. 3. F. Prereq: Chem 211. Tabatabai. Experimental and descriptive inorganic and organic analysis. Operational theory and principles of applicable instruments, including spectrophotometry, atomic and molecular absorption and emission spectroscopy, mass spectrometry, X-ray diffraction and fluorescence, gas and ion chromatography, and specific-ion electrodes.

561. Irrigation Agriculture. (2-0) Cr. 2. F. S. Prereq: 354. Troeth. Properties of soils in relation to irrigation; use and quality of irrigation water; reclamation of saline and sodic soils; management of irrigated cropland; irrigation in humid regions.

575. Soil Morphology, Genesis and Classification. (3-0) Cr. 3. F. S. Prereq: 472, 533. Morphology and formation of soils, systems of classification and geographical distribution of soils.

577. Soil Physics. (2-0) Cr. 2. F. S. Prereq: 354; Math 166 recommended. Relation to physical properties of soils to plant growth, particle size distribution, soil structure, clay minerals, soil moisture, soil air, and soil temperature.

578. Laboratory Methods in Soil Physics. (1-3) Cr. 2. S. Prereq: 357. Methods of measuring soil physical properties such as texture, density, water content, and transport of heat, water and gases.


590. Special Topics. Cr. arr. Prereq: 15 credits in agronomy. Literature reviews and conferences on selected topics in crops, soils, or climatology according to needs and interest of student.

599. Creative Component. Cr. arr. Prereq: Northside M.S. only. One written report of research library readings, or topics related to the student’s area of specialization and approved by the student’s advisory committee.

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
H. Soil Morphology & Genesis
I. Soil Physics

Courses for Graduate Students, major or minor

600. Seminar. (1-0) Cr. 1. Reports and discussion of recent literature research.
A. Crops, F. S. Carlson or Hallauer.
B. Soils, F. S. Staff
C. Soil-Plant-Climate, F. S. Staff

609. Agricultural Climatology Conference. (0-1) Cr. 1. F. S. S. Prereq: Permission of instructor. Carlson, Shaw Literature reviews with instructor on special problems relating to agricultural climatology, beyond the scope of current courses offered.


619. Professional Development in Crop Production and Physiology. (1-0) Cr. 1. Alt. F., offered 1981. Prereq: Permission of instructor. Shibles, Wedin. The organization of agricultural research in the United States; instruction and practice in research proposal preparation, writings of professional papers, and presentation of papers at national meetings; organization and teaching of university-level courses; advising graduate students; the extension education career; vita preparation, interview interaction, other professional-related topics.

620. Colloquium in Crop Production and Physiology. (1-0) Cr. 1. F. S. Prereq: Permission of instructor. Anderson. Presentation of papers and informal discussion of related literature topics in crop physiology and crop production.

621. Advanced Plant Breeding. (3-0) Cr. 3. S. Prereq: 521. Staff. Principles and concepts of selection, inbreeding depression and heterosis; development of parental materials; prediction of hybrid and synthetic performance, general and specific combining ability procedures, and problem in progeny evaluation.

Animal Ecology

Robert C. Summerfelt, Chair of Department

The Graduate Faculty

Members: Aitchison, R. W. Bachmann, Best, Carlander, Dahlgren, Dinsmore, Klaas, Menzel, Summerfelt

Associate Members: M. D. Bachmann, Clark, Franklin, Hubert, Moorman, Nickum

The department offers work for the degrees of Master of Science and Doctor of Philosophy with majors in animal ecology, fisheries biology, and wildlife biology. In addition to major work, the student may also specialize in animal behavior, ecology, limnology, or taxonomy.

The Ph.D. degree requires proficiency in one foreign language. This 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.

Personnel of the U.S. Fish and Wildlife Service, through the Iowa Cooperative Fishery and Wildlife Research Units, and the Iowa State Conservation Commission contribute to the graduate program of the department. The department participates in the interdepartmental graduate program in Water Resources (see Index).

No more than two dual-listed animal ecology courses may be applied for major graduate credit.

Courses for Graduate Students, minor only

350. Wildlife Techniques and Habitat Analysis. (1-3 Cr.) 2. S. Prerequisite: 231, 320L. Techniques and methods used in research and management of wildlife with emphasis on inventory and manipulation of wildlife populations and habitat. Field trips.

351. Wildlife Planning, Policy, and Administration. (3-0) Cr. 2. Alt. F. Offered 1981. Prerequisite: A course in natural resource management. History and philosophy of wildlife administration, and modern methods for planning and implementing management policy. Intended for students interested in employment in public or private agencies dealing with natural resources.

541. Fish Culture. (2-3) Cr. 3. Alt. S. Offered 1985. Prerequisite: 231, 320L. Principles and techniques of fish propagation, hatchery operation, nutrition, and disease problems. Fee charged for field trips.

543. Advanced Fishery Management. (2-3) Cr. 3. F. Prerequisites: 321, 410, 440, 441. Survey and evaluation of principles and techniques used in research and management of fishery resources. Fee charged for field trips.

551. Wildlife Sociobiology and Management. (2-3) Cr. 3. Alt. S. Offered 1982. Prerequisite: 312, a course in wildlife management recommended. Examination and synthesis of social organizational and behavioral concepts important for wildlife management. Game and non-hunted wildlife species of the world treated.

590. Special Topics. Cr. An F & S. Prerequisite: Graduate classification, permission of instructor.

Courses for Graduate Students, major or minor

600. Seminar. (2-0) Cr. 1. Each time taken, may be taken more than once for credit for graduation. F.S. Prerequisite: Permission of instructor or graduate classification. Written permission of the instructor is prerequisite to written permission of the coordinator of the graduate program in Water Resources (see Bulletin). This bulletin is usually available from participating departments after February 15.

*Courses Offered at the Iowa Lakeside Laboratory

320L. Field Biology. (4-12) Cr. 3. SS. Animals in the field, with particular emphasis on their recognition and on collecting, preserving, and laboratory culture methods. Field trips. Must be taken concurrently with Bot 301L.

508L. 509L. Aquatic Ecology. (8-24) Cr. each SS. Survey of local aquatic organisms and aquatic habitats, analysis of physiographic, physical, and chemical factors. Emphasis on field trips and basic ecological principles. Field trips.

**Courses Offered at the Gulf Coast Research Laboratory, Ocean Springs, Mississippi.

412G. (ZQ 452) Marine Ecology. Cr. 4. Prerequisite: Courses in general botany, invertebrate zoology and analytical chemistry. A consideration of the relationship of marine organisms to their environment, with special emphasis on factors affecting the abundance of organisms, pollution, and feeding relationships. Credit may not be earned for both the marine biology course and the marine ecology course.

442G. (ZQ 442) Marine Fisheries Management. Cr. 4. A general course in fisheries management designed to acquaint students with the philosophy, objectives, problems, and principles involved in management decisions. Lectures will include specialists in biology, fisheries statistics, sanitation, and law.

*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.

**Written permission of the coordinator of the Gulf Coast Research Laboratory, 2001 Louisiana, Mississippi, is prerequisite to all courses offered at the Laboratory. Numbers beginning with ZQ are GCRL numbers. Courses offered may vary from year to year.
Animal Science

S. A. Ewing, Head of Department

The Graduate Faculty

Members: Anderson, Beitz, Berger, Burroughs, Ewan, Ewing, Ford, Foreman, Freeman, Hoffmann, Jacobson, Kline, Lush, McGilliard, Melampy, Nordskog, Olson, Owings, Parrish, Robson, Rothschild, Sebranek, Self, Speer, Stromer, Trenkle, Wiggers, Willham, Young, Zimmerman

Associate Members: Brackelsberg, Christian, Hassak, Jurgens, Kenealy, Rust, Spike, Wunder

The department offers work for the degrees of Master of Science and Doctor of Philosophy with majors in animal breeding and nutrition, meat science, muscle biology, nutritional physiology, poultry nutrition, pork products technology, physiology of reproduction, and molecular, cellular and developmental biology. 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 co-major with one of these areas. Graduate work in meat science is offered as a co-major in animal science and food technology.

The department also cooperates in the interdepartmental program of Immunobiology. (See Index.)

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.

Courses for Graduate Students, major or minor

144G. (20 464) Marine Aquaculture. Cr. 6. Prereq: general zoology or invertebrate zoology. A lecture, laboratory, and field course designed to introduce aquatic and marine biology students to the history, principles, problems, and procedures relating to the culture of commercially important crustaceans, fish, and mollusks along the Gulf Coast.

144G. (20 464) Marine Aquaculture. Cr. 6. Prereq: general zoology or invertebrate zoology. A lecture, laboratory, and field course designed to introduce aquatic and marine biology students to the history, principles, problems, and procedures relating to the culture of commercially important crustaceans, fish, and mollusks along the Gulf Coast.


680. Modern Views of Nutrition. (F N 680) (2-0) Cr. R. S. Current concepts in nutrition and related fields. Required for all graduate students in nutrition.

684. Seminar in Meat Science. (1-0) Cr. 1. S. Prereq: Permission of instructor. Discussion and evaluation of current topics in research publications in meat science.

685. Seminar in Muscle Biology. (1-0) Cr. 1. S. Prereq: Permission of instructor. Reports and discussion of recent literature and current investigations.


Anthropology
For description of courses, see Sociology and Anthropology.

Architecture
Chair of Department

The Graduate Faculty
Members: Greenfield, Shao, Woods
Associate Members: Bock, Findlay, Hawk, Heemstra, Kainlauri, Kitzman, Kocimski (Emeritus), Lorr, Masterson, McKeown, Mukerjea, Osterberg, Robinson, Shank, Slater, Stone

The department offers several graduate programs leading to the professional degree Master of Architecture with major in architecture. Minor work is offered to students taking minor work in other departments.

The programs leading to the Master of Architecture degree are 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.

Courses for Graduate Students, major or minor, open to qualified undergraduates

651. Seminar. (2-0) Cr. 2. S. F S. Professional philosophy. Investigation of traditional and new roles in architectural practice.

652. Seminar. (1-0 to 3-0) Cr. 1 to 3 each time taken. S. F. Investigation of the changing relationships between professional practice and the needs of society.

507. Urban Housing Studio. (0-18) Cr. 6. F. S. Prereq: Admission to the B. Arch. or graduate program. Design of moderate to high density housing in urban environments.

508. Urban Design Studio. (0-18) Cr. 6. F. S. Prereq: Admission to the B. Arch. or graduate program. Urban design processes applied to contemporary urban settings.

509. Environment-Behavior Studio. (0-18) Cr. 6. F. S. Prereq: Admission to the B. Arch. or graduate program. Solving physical environment problems through the analysis of human behavior.


515. Concepts in Building Fire Safety. (3-0) Cr. 3. S. S. Prereq: 306, 311, 312 or ME 440 or ME 442. Theory of fire behavior, site planning for fire apparatus, materials, construction, detection, suppression, escape and refuge, codes as they relate to architecture. Field trip.

516. Construction Methods. (3-0) Cr. 3. F. F. Prereq: 311, 312, or ME 440 or ME 442. Advanced study of construction methods and procedures. Field trip.

517. Advanced Studies in Building Systems. (3-0) Cr. 3. S. Prereq: 512 or ME 440 or ME 442. Integration and development of technical building systems. Field trip.

521. Topical Studies in History, Theory, and Criticism of Architecture. (3-0) Cr. 3 each time taken. F. S. Prereq: Permission of instructor. Field trips.


533. Advanced Three-Dimensional Studio. (0-6) Cr. 2 each time taken. F. S. Prereq: 204. Advanced investigation of sculptural expression with emphasis on individual interest. No more than 8 credits may be applied toward a degree in architecture for the sum of credits earned in 332 and 533.

541. Human Thermal Environments. (M E 541) See Mechanical Engineering.

543. Office Practice. (3-0) Cr. 3. S. Prereq: 311, 312, 306. Emphasis on materials, techniques, drawing, office procedures, and administration. Field trip.

544. Advanced Topics in Architectural Technologies. (3-0) Cr. 3 each time taken. F. S. Prereq: 311, 312. Field trips.

Courses Primarily for Graduate Students, major or minor, open to qualified undergraduates


502. Seminar. (1-0 to 3-0) Cr. 1 to 3 each time taken. F. S. Investigation of the changing relationships between professional practice and the needs of society.

507. Urban Housing Studio. (0-18) Cr. 6. F. S. Prereq: Admission to the B. Arch. or graduate program. Design of moderate to high density housing in urban environments.

508. Urban Design Studio. (0-18) Cr. 6. F. S. Prereq: Admission to the B. Arch. or graduate program. Urban design processes applied to contemporary urban settings.

509. Environment-Behavior Studio. (0-18) Cr. 6. F. S. Prereq: Admission to the B. Arch. or graduate program. Solving physical environment problems through the analysis of human behavior.


515. Concepts in Building Fire Safety. (3-0) Cr. 3. S. S. Prereq: 306, 311, 312 or ME 440 or ME 442. Theory of fire behavior, site planning for fire apparatus, materials, construction, detection, suppression, escape and refuge, codes as they relate to architecture. Field trip.

516. Construction Methods. (3-0) Cr. 3. F. F. Prereq: 311, 312, or ME 440 or ME 442. Advanced study of construction methods and procedures. Field trip.

517. Advanced Studies in Building Systems. (3-0) Cr. 3. S. Prereq: 512 or ME 440 or ME 442. Integration and development of technical building systems. Field trip.

521. Topical Studies in History, Theory, and Criticism of Architecture. (3-0) Cr. 3 each time taken. F. S. Prereq: Permission of instructor. Field trips.


533. Advanced Three-Dimensional Studio. (0-6) Cr. 2 each time taken. F. S. Prereq: 204. Advanced investigation of sculptural expression with emphasis on individual interest. No more than 8 credits may be applied toward a degree in architecture for the sum of credits earned in 332 and 533.

541. Human Thermal Environments. (M E 541) See Mechanical Engineering.

543. Office Practice. (3-0) Cr. 3. S. Prereq: 311, 312, 306. Emphasis on materials, techniques, drawing, office procedures, and administration. Field trip.

544. Advanced Topics in Architectural Technologies. (3-0) Cr. 3 each time taken. F. S. Prereq: 311, 312. Field trips.
A student in the graduate program may select either a thesis or nonthesis option under the department Master of Arts degree program. The thesis option requires a minimum of 30 graduate credit hours and the completion of a thesis. The nonthesis option requires a minimum of 34 credit hours and the development of a research project, or an exhibition. In either option a minimum of 6 credit hours of related course work is required outside of the department. Specific information about the requirements for either of the degree options is available from the departmental office.

The department also cooperates in the interdepartmental minor program of Housing (see Index).

433. Advanced Painting. (1-5) Cr. 3 each time taken, maximum of 9. F.S. Prereq: 333. Figurative and/or non-figurative painting with extended work in media and composition. Fee.

450. Advanced Drawing. (1-5) Cr. 3 each time taken, maximum of 9. F.S. Prereq: 235. Figurative and/or non-figurative drawing with extended work in media, composition, and theory. Fee.

469. Commercial Interior Design II. (2-6) Cr. F.S. Prereq: 369. Credit or classification in 463 Research and design problems relating to specialized institutional environments and complex multi-unit planning. Professional ethics, general business procedures, and written specifications. Fee.

471. Graphic Illustration. (1-5) Cr. 3 F.S. Prereq: 370 Experiences with varied techniques in both black and white and color. Fee.

Courses Primarily for Graduate Students, major or minor

550. Advanced Drawing. (1-5) Cr. 3 each time taken, maximum of 9. F.S. Prereq: 12 credits of undergraduate drawing. Figurative and/or non-figurative drawing with extended work in media, composition, and theory. Fee.

590. Special Topics. Cr. 1 to 5 each time taken, F.S. SS. Prereq: Written approval of instructor and department head. Projects of special interest to the student.

Courses for Graduate Students, major or minor

605, 606. Architectural Design. (0-15) Cr. 5 each. 605: F. 606: S. Prereq: Admission to M. Arch. program. Architectural design problems of increased complexity.


608. Individual Design Projects. (0-9 to 0-36) Cr. 3 to 12 each time taken. F.S. Prereq: Approval of major professor.


Biochemistry and Biophysics

James Allen Olson, Chair of Department

The Graduate Faculty

Members: Applequist, Atherly, Beltz, Brenmer, Cox, Foss, French, Fromm, Graves, Hammond, Horowitz, Melitzer, Olson, Olufka, Rebers, Robinson, Robert, Rougvie, Stone, Stremme, Thomas, Tipton, Warner, Young

Associate Member: White

The department offers work for the degrees of Master of Science and Doctor of Philosophy with majors in biochemistry; biophysics; and molecular, cellular, and developmental biology; and minor work to students taking major work in other departments.

The department also participates in the interdepartmental programs in immunobiology, and Molecular, Cellular, and Developmental Biology. (See Index.)

Prerequisite to graduate work is completion of sufficient undergraduate work in chemistry, mathematics, physics, and biology.

All graduate students are required by the department to teach as part of their training for an advanced degree.

Candidates for the degree doctor of philosophy must demonstrate a reading knowledge of one foreign language, preferably French, German, or Russian, either by passing (50th percentile or better) the Educational Testing Service examination or obtaining a grade of C or better in a one-year college course in a foreign language. A foreign student whose native language is Chinese, French, German, Italian, Japanese, Russian, or Spanish may be excused from the foreign language requirement.

Courses for Graduate Students, minor only

1*404, 1*405. Biochemistry. (3-0) Cr. 3 each. Yr. Prereq: 404: Chem 332; 405: 404. A fundamental rigorous treatment for graduate and advanced undergraduate students in agricultural, biological, and nutritional sciences. 404: Chemistry of amino acids, proteins, carbohydrates, lipids, vitamins, and nucleotides, enzymology, metabolism of carbohydrates and fats. 405: Metabolism of amino acids and nucleic acids, biosynthesis of membranes, DNA, RNA, and proteins, genetic code, metabolic regulation; comparative biochemistry and biochemistry.

411. General Biochemical Research Techniques. (1-4) Cr. 3. F. Prereq: 201 or 404 or 501, Chem 210 or 211. Introduction to techniques for studying biochemistry, including: paper, gas, and column chromatography; enzyme isolation and kinetics; use of radioisotope tracers.

1*420. Physiological Chemistry. (4-0) Cr. 4. F. Prereq: 301 and Chem 332. Structure and function of proteins; enzymeology, biological oxidation, chemistry and metabolism of carbohydrates, lipids, amino acids and nucleic acids; protein synthesis and the genetic code; relationship of biochemistry to selected animal diseases, Biochemistry of higher animals will be emphasized. Not acceptable for credit toward a major in biochemistry or biophysics.

451. Introduction to Physical Biochemistry. (2-0) Cr. 2. S. Prereq: Chem 331, Phys 112 or 222, a previous course in calculus is helpful but not required. Selected topics in physical chemistry in the context of applications to problems in biology, biochemistry and food sciences. Not acceptable for credit toward a major in biochemistry or biophysics.

461. Introduction to Biophysics. (2-0) Cr. 2. F. Prereq: 451 or Chem 321 or 324 or Phys 304. Biological phenomena viewed as problems in physics. Survey of selected topics such as bioenergetics, muscle contraction, nerve conduction, vision, and macromolecular behavior.
Courses Primarily for Graduate Students, major or minor, to open to qualified undergraduates

501, 502. General Biochemistry. (4-0) Cr. 4 each. Yr. Prereq: 501: Chem 210 or 211, 332; and 322 or 325; 502: 501. Chemical composition of living matter and the chemistry of life processes: 501: Chemical characterization of proteins, carbohydrates, lipids, and nucleic acids; membranes, enyzymology and co-enzymes; metabolism of carbohydrates and lipids; biological oxidations. 502: Metabolism of amino acids and nucleotides; biosynthesis of DNA, RNA, and proteins; genetic code; hormones and metabolic regulation; molecular immunology, and biochemistry. Prereq: 501. For graduate students in biochemistry and biophysics, advanced undergraduates in biochemistry or chemistry, and qualified students desiring a rigorous course.

511. Topics in Experimental Biochemistry. Cr. var. 1-3. S. Prereq: 404 or 501 and Chem 210 or 211. A laboratory course in biochemical uses of radiospectroscopy. Basic counting techniques, liquid scintillation counting, isoceze dilution techniques, radio-autography, radioimmunoassay, and elucidation of reaction mechanisms using labeled compounds.

521. Radiochromatography. (2-6) Cr. 2 S 8 weeks. Prereq: 404 or 501 and Chem 210 or 211. An laboratory course in biochemical uses of radiospectroscopy. Basic counting techniques, liquid scintillation counting, isoceze dilution techniques, radio-autography, radioimmunoassay, and elucidation of reaction mechanisms using labeled compounds.


551. Molecular Biophysics. (3-0) Cr. 3 F. Prereq: Math 166, permission of instructors. Foss, Roug. An examination of physical methods for the study of the molecular structure and organization of biological materials, with emphasis on applications.


575. Laboratory in Microscopy. (0-6) Cr. 2 S. Prereq: Credit or classification in 514 Outka. Practical experience in microscopy. Designed to be taken concurrently with 574.

581. Seminar. (1-0) Cr. 1 F. Prereq: Permission of instructor. Short talks and discussion by students on assigned topics. For entering graduate students and qualified seniors.

590. Special Topics. F, S, SS. Cr. arr.

591. Optical Instrumentation Laboratory. Cr. 1 S. Prereq: Permission of instructor. Foss. Training in the operation of spectrophotometers, spectrophonofluorimeter, and dichrograph. A concentrated one week course for students planning research use of this instrument.

592. Analytical Ultracentrifugation Laboratory. Cr. 1 S. Prereq: Permission of instructor. Roug. Training in the operation of the analytical ultracentrifuge. A concentrated one week course for students planning research use of this instrument.

Courses for Graduate Students, major or minor

615. Molecular Immunology. (Micro 615) (2-0) Cr. 2 F. Warner. Prereq: 405 or 502. Contemporary topics in immunobiology, immunology, and immunogenetics.


645. Biochemistry of Metabolic Regulation. (3-0) Cr. 3. Alt. F., offered 1981. Bartz, Thomas. Prereq: Credit or classification in 420, 420, or 501. Advanced topics in regulation of metabolism with emphasis on important regulatory molecules, and mechanisms of enzyme regulation. The second half of the course will deal extensively with molecular mechanisms of selected hormones.


652. Protein Chemistry. (2-0) Cr. 2 Alt. S., offered 1983. Graves, Robyt. Prereq: 404 or 501. Chemical reactions and physical changes of proteins as a means of determining their structures and biological functions.


681. Advanced Seminar. Cr. 1 F, S. Prereq: Permission of instructor. Student presentations.

682. Departmental Seminar. Cr. H F, S. Prereq: Permission of instructor. Student staff and visitor presentations.

688. Seminar in Molecular, Cellular, and Developmental Biology. (MCDB 688) See Molecular, Cellular and Developmental Biology.

699. Research. Prereq: Permission of instructor.

Biological Engineering

(Interscational Program)

Richard C. Seagrave, Professor in Charge

The Graduate Faculty

Members: Brockman, Croklin, Engen, R. T. Greer, Seagrave, Swift, Young

Associate Members: Carithers, Carlson, M. H. Greer.

The Biomedical Engineering (BME) Program is interdisciplinary in scope and is sponsored jointly by the colleges of Engineering and Veterinary Medicine. Biomedical engineers 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 phenomena of living systems which have functional capabilities desirable in the design of physical systems. Following completion of biomedical engineering training, they engage in research careers in the various fields of biomedicine and engineering, and in the environmental sciences. They may work on multidisciplinary teams in industrial, governmental, or academic research institutes. Individuals with this training can correlate and adapt engineering principles to the problems of medicine and biology by utilizing engineering knowledge to increase understanding of the functions of biological systems, and by developing new quantitative methods for scientific investigation, and for diagnosis and therapy.

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 BME major will usually elect minor work in one of the following curricula: biochemistry and biophysics, chemistry, electrical engineering, engineering mechanics, mathematics, medical engineering, psychology, veterinary anatomy, veterinary clinical sciences, veterinary pathology, veterinary physiology, or zoology. All students are encouraged to obtain previous background knowledge of organic chemistry, calculus, beginning differential equations, and physics.
Courses Primarily for Graduate Students, major or minor

520. Biomechanics. (E M 520) (3-0) Cr. 3. S. Prereq: Phys 221. Microscopic and gross anatomy with emphasis on functional relationships and engineering design.

525. Anatomy and Physiology for Biomedical Engineers. (2-1) Cr. 3. F. Prereq: Phys 221. Microscopic and gross anatomy with emphasis on functional relationships and engineering design.

530. Biothermodynamics and Transport Phenomena. (3-0) Cr. 3. S. Prereq: Math 176 or 266, Phys 222. The principles of thermodynamics and transport phenomena applied to the study of physiology and the design and operation of artificial organs and life support systems.


555. Biomedical Fluid Mechanics. (E M 555) (3-0) Cr. 3. S. Prereq: 520. Application of principles and concepts of fluid mechanics to problems in biology and medicine. Hemodynamic characteristics of the circulation, rheology of blood, flow in the microcirculation, flow in the large arteries, and the respiratory system.


565. Electrophysiology. (2-0) Cr. 2. S. Prereq: 551, Math 176, Phys 222. Electrical events in living systems. Mathematical and electrical models for resting and action potentials in nerves and for transmission between cells.

570. Biomedical Instrumentation. (3-0) Cr. 3. S. Prereq: E E 441. Characteristics of biological signals, transducers, error and artifact suppression, biological data acquisition and processing systems.

575. Simulation of Biological Systems. (3-0) Cr. 3. F. Prereq: 525, 530. Development of mathematical models for living systems, including control systems, population dynamics, cardiovascular and respiratory systems, and anesthesia delivery systems. Consideration of the use of simulation techniques in biological systems.

580. Biometry. (E M 580, M S E 580) (3-0) Cr. 3. S. Prereq: M S E 270, permission of instructor. Presentation of the basic chemical and physical properties of biomaterials as they are related to their manipulation by the engineer for incorporation into living systems. Role of microstructure properties in the choice of biomaterials and design of artificial organs, implants, and prostheses.

585. Information Processing in Living Systems. (3-0) Cr. 3. S. Prereq: E E 441. Neurons and nervous network models, information processing in living systems, artificial intelligence, pattern recognition.

590. Special Topics. Cr. 1 to 5 as arranged. Investigation of problems of special interest in biomedical engineering.

595. Biomedical Data Processing. (2-0) Cr. 2. F. Prereq: E E 441. Digital data acquisition systems used in biomedical research, hardware, data reduction algorithms, digital filters.

Courses for Graduate Students, major or minor

610. Cardiovascular Transport and Control. (2-0) Cr. 2. S. Prereq: 525, 530. Quantitative biophysics underlying the transport of material and energy in the cardiovascular system with special emphasis on control.

615. Experimental Surgery. (1-3) Cr. 2. SS. Prereq: 525. Advanced surgical processes for quantitative studies in biomedical engineering.

690. Advanced Topics. Cr. 1 to 5 as arranged.

A. Instrumentation

B. Simulation

C. Transport Phenomena

D. Biomaterials

E. Information Processing

999. Research.

Botany

Ronald C. Coolbaugh, Chair of Department

The Graduate Faculty

Members: Anderson, Bowen, Coolbaugh, Davis, Dodd, Farrar, Glenn-Lewin, Horner, Isely, LaMotte, Lersten, Nevins, Oktia, Pohl, Smith, Stewart, Swenson, Tiffany, van der Valk

Associate Members: Chapman, Pearlmutter

The department offers work for the degrees of Master of Science and Doctor of Philosophy with a major in botany, 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.

The department also participates in the interdisciplinary programs of Water Resources, and Molecular, Cellular, and Developmental Biology.

500. Field Biology of Freshwater Algae. (2-3) Cr. 3. S. (SS Lakeside Cab.) Prereq: 10 credits in biological sciences. Dodd. Introduction to major groups of algae and their roles in fresh-water habitats. Environmental factors affecting growth and reproduction. Fee for field trips. May be taken in summer at Iowa Lakeside Laboratory with written permission of instructor.


512. Plant Growth Regulation. (3-0) Cr. 3. S. Prereq: 320, Phys 111 or 221, Chem 331. LaMotte. Vascular plant growth regulation, cellular proliferation, development, and hormones involved in their regulation.


519. Fine Structure of Plant Cell. (3-0) Cr. 3. Alt. S. off ered 1983. Prereq: 310 or 350. 404. Structure and function of organs, tissues, cells, and cellular components at various levels of evolutionary development.

544. Laboratory in Cytology. (0-3) Cr. 1. Prereq: A course in cell biology or histology. Prereq: in 444 Optional laboratory to accompany 444. Light microscopic study of the nucleus and chromosomes.


559L. Field Biology of Bryophytes and Pteridophytes. (See list of courses offered at Iowa Lakeside Laboratory.)

564. Wetland Ecology. (2-3) Cr. 3. F. Prereq: 10 credits in biological sciences; wart der Valk. Role of vascular plant communities in lakes, rivers, marshes, and...


584. Plant Communities and Ecosystems. (3-3) Cr. 3. S. Prereq: 424 or 484. Historical survey of approaches to the study of plant communities and ecosystems.

585. Advanced Field Ecology. (0-6) Cr. 2 each time taken. F.S. Prereq: Graduate classification. Weekend and extended field trips to various vegetation types with emphasis on field problems. Report required. Fee charged.


590. Special Topics. Cr. 1 to 3 each time taken. Prereq: 10 credits in botany, permission of instructor.

A. Morphology
B. Physiology
C. Mycology
D. Taxonomy
E. Plant Ecology
F. Economic Botany
G. Aquatic Plant Ecology


Courses for Graduate Students, major or minor


641. General Mycology. (2-6) Cr. 4 each. Yr. Prereq: PP SW 407, or 416, or 417. Tiffany. Taxonomy, morphology, and physiology of algae, suture molds and fungi (phycocyanes, ascomycetes, basidiomycetes, and fungi imperfecti).


684. Plant Ecology Colloquium. (2-0) Cr. 2 each time taken. F.S. Prereq: permission of instructor. Discussion of ecological literature and research: term paper and oral presentation; different topic chosen by instructor each semester.


689. Seminar. Cr. 1 each time taken. Meetings of botany staff and students to discuss recent literature and problems under investigation.

A. Morphology and Taxonomy
B. Plant Physiology
C. For all staff and students in botany
D. Molecular, Cellular, and Developmental Biology (MCDB)
E. Ecology

**Courses Offered at the Iowa Lakeside Laboratory**

301L. (L:101) Field Botany. (4-12) Cr. 2.5. SS. A study of plants in natural environments; includes methods of identification, collection, and preservation as basic ecological concepts. Field trips. Must be taken concurrently with Zoot 320L.

490. Independent Study. (See preceding section.)


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 Lakeside Laboratory Bulletin. This bulletin is usually available from the School of Business Administration.*

**Courses for Graduate Students, minor only**

Accounting (Acct)

480. Cost Accounting. (3-0) Cr. 3. F. Prereq: 265. Product costing and control as related to job order, process, and standard cost systems, introduction to cost-volume-profit relationships, operational budgeting, and responsibility accounting.

481. Advanced Cost Accounting. (3-0) Cr. 3. F. Prereq: 480. Further development of product costing and control procedures. Includes variable costing, capital budgeting, distribution costs, investment and profit centers. Transfer pricing, inventory planning, decision models, mix and yield variances. Field trips.

485. Federal Income Tax. (3-0) Cr. 3. F. Prereq: 381 or 284. Emphasis on fundamentals of income tax related to individual taxpayers. Transaction planning to maximize participation in preferential tax opportunities. Limited exposure to characteristics of estate and gift taxes. Introduction to concepts involved in taxation of corporations and partnerships.

488. Governmental and Non-profit Institution Accounting. (3-0) Cr. 3. SS. Prereq: 285. Budgeting, accounting, auditing, and financial reporting principles associated with private and public nonprofit organizations. Includes survey of state, local, municipal, and federal government accounting; college, university, and endowment funds.

Finance (Fin)

451. Real Estate Finance. (3-0) Cr. 3. S. Prereq: 351. Decision making in the financing of real estate using basic analytic tools including the applications of various compound interest tables. Principal instruments involved in financing real estate, risk and return analysis, financing techniques, and major institutional sources of funds.

452. Advanced Business Finance. (3-0) Cr. 3. F. Prereq: 350. Theory used in a firm’s investment and financing decisions. Analysis of environment in which financial decisions are made. Applications of analytical techniques to problems involved in financial decisions.

454. Principles of Investments. Cr. 3. F. Prereq: 350. Econ 201. Introduction to various investment media and markets from the viewpoint of the individual investor. Emphasis on financial planning, behavior of security markets, corporate stocks and bonds, individual asset and portfolio selection techniques. Term project required.


Life Insurance. (3-0) Cr. 3. Alt. F., offered 1982. Prereq: 357. In-depth analysis of health, social, and life insurance. Major emphasis on group policies, retirement plans, business uses of life insurance, and estate planning.

Finance Seminar. (3-0) Cr. 3. F.S. Prereq: 452. Contemporary problems and current research in management. Readings from current periodicals. Problem and case analysis investigating those areas requiring financial decisions.

Management (Mgmt)

Introduction to Management Information Systems. (3-0) Cr. 3. F.S. Prereq: 370. COn S 111 or 127 or 175. Computer-based management information systems and how such systems support decision-making in all levels of management. The development, organization, management control, and evaluation of information systems activities. Societal implications of the use of the computer in business.

Applications in Business Information Processing. (3-0) Cr. 3. F.S. Prereq: 370. ConS 201. Design and development of business applications in COBOL, COBOL, and its use in developing data processing applications, methods and issues impacting on processing and information retrieval purposes, availability of generalized software packages, and the information science interface with other functional areas of business.

Business Information Systems Analysis. (3-0) Cr. 3. S. Prereq: 372. Feasibility studies, identification of management decision requirements, approaches and techniques for the analysis and description of information flows, and managerial control of systems development.

Organization Theory. (3-0) Cr. 3. F.S. Prereq: 371. A macro view of organizations. Emphasis on the organization itself, rather than on people in organizations. Existing theoretical frameworks are employed to better understand why organizations are structured as they are and why they behave as they do.


Management Seminar. (3-0) Cr. 3. S. Prereq: Senior classification in management, permission of the instructor. Selected problems in management.

Marketing (Mkt)


Marketing Research. (3-0) Cr. 3. F.S. Prereq: 447. Stat 228. Marketing research techniques: problem formulation, research design, questionnaire construction, sampling, data collection procedures, and analysis and interpretation of data related to marketing decisions.

Sales Forecasting. (3-0) Cr. 3. S. Prereq: 340. Stat 228 recommended. Time series, analysis by regression, exponential smoothing, cycle analysis, and other mathematical models, by using an interactive program on a VAX terminal and case analysis.

Consumer Behavior. (3-0) Cr. 3. F.S. Prereq: 340. Application of concepts and methods of the behavioral sciences to marketing management decision making.

Marketing Seminar. (3-0) Cr. 3. S. Prereq: 447. Analysis of current problems in marketing with emphasis on new theoretical and methodological techniques for solving these problems.

Transportation/Logistics (TrLog)

Logistics Management. (3-0) Cr. 3. F.S. Prereq: 360. Advanced business logistics, stressing materials management and quantitative approaches to design and operation of the total logistics system. Evaluation and solution of logistics cases.

Transportation Carrier Management. (4-0) Cr. 4. F.S. Prereq: 360. Transportation and management decisions for air, water, motor railroad, and pipeline modes. Regulatory policies, ownership and management problems, pricing, labor, and competitive relationships.

Urban and Rural Transportation Management. (3-0) Cr. 3. F. Prereq: 360. Urban and rural passenger transportation from a managerial viewpoint. Analysis of transit operations, financing, marketing, personnel, and labor problems, federal and state aid, and a contrast between urban and rural transportation.

Transportation and Public Policy. (3-0) Cr. 3. F. S. Prereq: 360. 492 and senior classification. Analysis of current major issues and of pertinent studies on national policy, including recent and proposed legislation. Evaluation of impact of policy changes on carriers and economy. Individual project required.

Transportation & Logistics Seminar. (3-0) Cr. 3. F. S. Prereq: 460, 464, 468 and senior classification. Research in contemporary problems in transportation and logistics.

Ceramic Engineering

For description of courses, see Materials Science and Engineering.

Chemical Engineering

Maurice A. Larson, Chair of Department

The Graduate Faculty

Members: Abraham, Arnold, Bautista, Boylan, Burkhardt, Burnett, Hill, Larson, Pulsifer, Reilly, Seagrove, Sheeler, Shuck, Ulrichson, Wheelock

Associate Members: Glatz, Jolls

The department offers work for the degrees of Master of Science, Master of Engineering, and Doctor of Philosophy with major in chemical engineering, and minor work for 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.

The Master of Engineering degree requires an independent study project. A thesis is required for the Master of Science degree.

Interdepartmental programs between chemical engineering and biomedical engineering are provided under the sponsorship of the colleges of Engineering and Veterinary Medicine. Laboratory facilities are available in both biomedical engineering and chemical engineering. See Biomedical Engineering.

The department also participates in the interdepartmental program of Water Resources, and in the interdepartmental minor program of Energy Systems Engineering. (See Index.)

Courses for Graduate Students, minor only

Momentum Transport Operations. (3-0) Cr. 3. F.S. Prereq: 370. COn S 172, Phys 221. Credit or classification in Math 267. Momentum and mechanical energy balances. Incompressible and compressible fluid flow. Applications to fluid drag, piping system design, filtration, packed beds and settling.

Heat and Mass Transfer. (3-0) Cr. 3. F.S. Prereq: 360. Conduction and diffusion, convective heat and mass transfer, boiling and condensation, radiation, simultaneous heat and mass transfer, design of heat exchange equipment.

Mass Transfer Operations. (4-0) Cr. 4. F.S. Prereq: 370. Analysis and design of continuous contacting and multistage separation processes. Binary and multicomponent distillation, absorption, extraction, evaporation.

Chemical Engineering Laboratory I. (2-0) Cr. 1. S. Prereq: 320. Credit or classification in 320. Experiments covering basic chemical engineering measurements, material and energy balances, and momentum transport operation. Computer applications.

Chemical Engineering Laboratory II. (2-0) Cr. 1. S. Prereq: 324. Credit or classification in 321 and 332. Experiments in heat and mass transfer, thermodynamics, and chemical reactor performance.


Chemical Reactor Design. (3-0) Cr. 3. F.S. Prereq: 331. Credit or classification in 327. Kinetics of chemical reactions, design of homogeneous and heterogeneous chemical reactors.

Chemical Process Industries. (3-0) Cr. 3. S. Prereq: 331. Functional of the chemical process industries: raw materials, process routes, intermediates, products, economics and marketing.

Biochemical Engineering. (3-0) Cr. 3. S. Prereq: Chem 331. Application of basic chemical engineering principles in biotechnology to chemical and biological processes industries such as fermentation, food processing, enzyme technology, and biological waste treatment.

Process Control. (2-2) Cr. 3. S. Prereq: Credit or classification in 322, Math 267. Control of industrial chemical processes. Devices applications and limitations. Dynamics of chemical process components and process control systems.

Chemical Engineering Laboratory III. (3-0) Cr. 1. F. S. Prereq: 322, 325. Investigation of chemical engineering process equipment.


Modeling and Simulation. (2-0) Cr. 2. S. Prereq: 322, 332. Simulation of behavior of chemical processes, trial and error calculations, numerical integration, and other mathematical methods. Problems involving fluid flow, distillation, heat transfer, process control, and reactor design.
Chemistry

Robert J. Angelici, Chair of Department

The Graduate Faculty


Associate Members: Hutton, R. P. Johnson, Kurtz

The department offers work for the degrees Master of Science and Doctor of Philosophy with majors in analytical, inorganic, organic, and physical chemistry, as well as the degrees Master of Science and Doctor of Philosophy in chemistry. Co-majors may be taken between areas within chemistry or between one of the areas in chemistry and another department. Courses in other areas of chemistry as well as courses in other departments may be used to satisfy the requirement for course work outside the major field. Minor work is offered to students majoring in major work in other departments.

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.

For the Ph.D. degree, the foreign language requirement is reading proficiency in one of the following: German, Russian, French, or, in some special cases, Japanese.

Index to field of work is given by the second and third digits of course numbers:

(a) Inorganic Chemistry: 30-09
(b) Analytical Chemistry: 10-19
(c) Physical Chemistry: 20-29
(d) Organic Chemistry: 30-39
(e) General Chemistry: 60-79
(f) Research: 99

Courses for Graduate Students, major or minor

601. Seminar. (1-0) Cr. F. F.S. Offered on a satisfactory-fail basis only.


690. Advanced Topics. Cr. var.

Research.

Courses for Graduate Students, minor only

301. Inorganic Chemistry. (4-0) Cr. 4. Prereq: 324 or 321. Bonding in inorganic systems, descriptive and systematic chemistry of the elements. Emphasis on correlation of structure and bonding with chemical or physical properties of inorganic compounds; applications of thermodynamic and other physical methods to study of inorganic systems.

321. Physical Chemistry. (3-0) Cr. 3. F. Prereq: 210 or 211 or 178, Math 166 or Math 176, Physics 222 recommended. Kinetic theory of gases, classical thermodynamics with applications to gases, multicomponent, multiphase equilibrium of reacting systems, surface chemistry, and electrochemical cells. Students majoring in chemistry or biochemistry will ordinarily elect Chem 324, 325.

321L. Laboratory in physical chemistry. (1-3) Cr. 2. F. Prereq: Credit or classification in 321 recommended.

322. Physical Chemistry. (3-0) Cr. 3. F. Prereq: Chem 212 or 222. Solids, transport properties, chemical kinetics; quantum mechanics, atomic and molecular structure, spectroscopy, statistical thermodynamics.

331, 332. Organic Chemistry. (3-0) Cr. each. 331: F., S.; 332C: F. Prereq: 331: 178 or 210 or 211, classification in 333A highly recommended; 332: 331, classification in 334A highly recommended. Modern organic chemistry including nomenclature, synthesis, structure and bonding, reaction mechanisms, natural products, carbohydrates and proteins. For students majoring in physical and biological sciences, premedicall and prevetinary curricula, chemistry and biochemistry.

401L. Inorganic Chemistry Laboratory. (0-4) Cr. 1. F. Prereq: 301. Preparation and characterization of inorganic and organometallic compounds by modern techniques. For students majoring in chemistry or biochemistry.

426. Radiotracer Methods. (2-0) Cr. 2. F. Prereq: 322 or 325, Phys 112. Radiosotope techniques and their applications to problems in biology and allied sciences. For students in biology and agriculture.

Courses for Graduate Students, major or minor, open to qualified undergraduates

500. Advanced Inorganic Chemistry. (2-0) Cr. 2. F. Prereq: 301. 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. (0-4) Cr. 1. F. Prereq: 301. Preparation and characterization of inorganic and organometallic compounds by modern research techniques.

504. Organometallic Chemistry of the Transition Metals. (2-4) Cr. 2. Alt. S. Prereq: 322. Transition metal complexes of ligands such as cyclopentadienyl, olefins, acetylenes, benzenes, and carbon monoxide Homogeneous catalysis.

505. Physical Inorganic Chemistry. (3-0) Cr. 3. F. Prereq: 301 and 325 or 322. Elementary group theory and molecular orbital theory applied to inorganic chemistry. Spectroscopic methods of characterization of inorganic compounds.

506. Systematic Inorganic Chemistry. (3-0) Cr. 3. S. Prereq: 301 or 500 and 325. Descriptive chemistry of the metallic and nonmetallic elements.

509. Introduction to Inorganic Chemistry Research. (1-0) Cr. F. Prereq: 301. Students are assigned to the various areas of current research in inorganic chemistry at Iowa State University.

510. Advanced Survey of Analytical Chemistry. (2-0) Cr. 2. F. Prereq: 316. Selected topics in modern quantitative analysis including analytical separations, titrimetry, spectroscopy, and other instrumental methods.

511. Advanced Quantitative Analysis. (3-0) Cr. 3. S. Prereq: 316. General methods of quantitative inorganic and organic analysis. Aqueous, nonaqueous titrimetry; selective reagents; sampling and sample dissolution, and analytical literature.


513. Analytical Molecular and Atomic Spectroscopy. (3-0) Cr. 3. S. Prereq: 316, 325, 325L. Introduction to
516. Analytical Separations. (2-0) Cr. 2. F. Prereq: 316, 325, 325L. Principles and examples of inorganic and organic separation methods applied to analytical chemistry. Solvent extraction, volatilization, ion exchange, liquid and gas chromatography.

518. Advanced Quantitative Laboratory. (1-6) Cr. 3. S. Prereq: 512, 513 and 516. Instrumental methods of qualitative and quantitative chemical analysis.

520. Advanced Physical Chemistry. (2-0) Cr. 2. S. Prereq: 320 or 325. Principles of physical chemistry as they apply to analytical, inorganic, and organic chemistry, including structure, reaction mechanisms, kinetics, quantum mechanics and spectroscopy. For students not majoring in physical chemistry.


523. Chemical Spectroscopy and Structure. (3-0) Cr. 3. F. Prereq: 505 or 523, Phys 447. Maxwell’s field equations, interaction of electromagnetic radiation with matter including induced absorption and emission and spontaneous emission, microwave, infrared, Raman and electronic molecular spectroscopy, spectral lineshapes, introduction to solid state symmetry and structure.


526. Radiochemistry. (3-0) Cr. 3. Alt. S. offered 1982. Prereq: 320 or 325. Radioactivity, preparation and decay properties of radioactive nuclides, interaction of radiation and matter, chemistry of nuclear fission, instrumentation for radiation analysis, application of radiocactivity to chemistry, especially to analysis.

527. Surface Chemistry. (3-0) Cr. 3. Alt. F. offered 1982. Prereq: 320 or 325. Basic principles and applications.

528. Physical Inorganic Chemistry. (2-0) Cr. 2. S. Prereq: 322 or 325. Methods of studying reaction rates and mechanisms, inference of mechanisms from rate laws, reversible, consecutive, and competing reactions, chain mechanisms, exchange reactions, isotope effects, effects of pressure, temperature, theories of unimolecular reactions, absolute rate theory.

529. Introduction to Research in Physical Chemistry. (1-0) Cr. R. F. Introduction to the various areas of research in Physical Chemistry at the State University.

530. Advanced Organic Chemistry. (2-0) Cr. 2. S. Prereq: 332. Selected topics in modern organic chemistry, including structure, reaction mechanisms, organic synthesis and spectroscopy. For students not majoring in organic chemistry.

531. Physical Organic Chemistry. (2-0) Cr. 2. F. Prereq: 332. Molecular structure, stereochemistry, kinetics, linear free energy relationships, introduction to reaction mechanisms, nucleophilic and electrophilic substitution reactions.


533. Physical Organic Chemistry. (2-0) Cr. 2. S. Prereq: 331. Survey of reactive intermediates including carbonium ions, carbanions, carbones and free radicals.


570. (470 DL) Structure and Bonding. (2-0) Cr. 2. F. Prereq: 325. Graduate study in conjunction with 470. Not available for credit for students who have taken 470.

599. Nonthesis Research. Cr. arr. Prereq: Permission of staff member concerned.

Courses for Graduate Students, major or minor

600. Seminar in Inorganic Chemistry. (1-0) Cr. 1 each time taken. F.S. Prereq: Permission of instructor.

601. Selected Topics in Inorganic Chemistry. (2-0) Cr. 2 each time taken. F.S. Prereq: Permission of instructor. Topics such as chemical applications of group theory, molecular structure and bonding, organometallic compounds, physical techniques of structure determination, nonaqueous solutions, ligand field theory, solid state chemistry, and bio-inorganic chemistry.

611. Seminar in Analytical Chemistry. (1-0) Cr. 1 each time taken. F.S.


620. Seminar in Physical Chemistry. (1-0) Cr. 1 each time taken. S. Prereq: Permission of instructor.

621. Statistical Mechanics. (3-0) Cr. 3 each time taken. Offered every third year starting 1982 S. Prereq: Permission of instructor. Review of classical and quantum mechanics; principles of statistical mechanics, applications to thermodynamics and other related problems.


624. Dynamics of Spectroscopic Transitions. (3-0) Cr. 3 each time taken. Offered every third year starting 1984 S. Prereq: Permission of instructor. Photophysical and photochemical relaxation processes of molecular states and their implications for spectroscopic transitions.

625. Special Topics in Physical Chemistry. (2-0 or 3-0) Cr. 2 or 3 each time taken. F.S. Prereq: Permission of instructor. Topics such as atomic and molecular structure, surface chemistry, magnetic resonance, solid state spectroscopy, and chemical kinetics.

631. Seminar in Organic Chemistry. (1-0) Cr. 1 each time taken. F.S. Prereq: 531, permission of instructor.

632. Selected Topics in Organic Chemistry. (1-0) Cr. 1 each time taken. Prereq: 331. Topics of current interest in organic chemistry such as spectroscopy, physical organic chemistry, photochemistry, organometallic chemistry, mechanisms of oxidations and reductions, modern organic synthesis, reactive intermediates, heterocycles, and biosynthesis.

699. Research. Prereq: Permission of staff member concerned.

Courses for Graduate Students, minor only


Courses Primarily for Graduate Students, major or minor, open to qualified undergraduates


535. History and Theories of Early Childhood Education. (3-0) Cr. 3. F. Prereq: 524 or 6 credits in child development or psychology. History, theories, and trends in early education. Role of early education, including intervention models, in the total educational system.


Civil Engineering

Carl E. Ekberg, Jr., Head of Department

The Graduate Faculty

Members
Austin, Barbara, Brewer, Carstens, Cleasby, DeBarg, Dougall, Ekberg, Friedmann, Handy, Hardy, Hoover, Klauer, Lee, Lohnes, Morgan, Oulman, Porter, Sanders, Sheeler, Spangler, Young

Associate Members:
Fung, Jellinger, Kannel, Mickle, Ring, Russo, Wolde-Tinsae

Courses for Graduate Students, major or minor

A. Developmental Processes
B. Early Childhood Education
C. Community Services and Programs
D. Research
E. Professional Relations
F. Program Administration
G. College Teaching

Courses for Graduate Students, major or minor

A. Current Issues in Child Care
B. Developmental Processes in Children
C. Developmental Psychology
D. Exceptional Children
E. Guidance of Children
F. Parental and Infant Development
G. Parent and Family Issues
H. Research Issues in Child Development
I. Eminent Persons in Child Development


690. Research.

451. Urban Transportation Planning. (2-3) Cr. 3. S. Prez. 350 or 351. Planning of highway systems and terminals as part of a complete planning approach; public transportation planning; transportation planning studies, projections, analysis, plan formulation, and programming.


486. Civil Engineering Specifications. (2-0) Cr. 2. S. Prez. Star 105, credit or classification in Mgmt 315 or I.E 480. Contract documents, competitive bidding procedures for public work projects. Negotiated contracts for services, preparation and interpretation of specifications for civil engineering projects.

Courses Primarily for Graduate Students, major or minor, open to qualified undergraduates.

505. Public Works Engineering. (3-0) Cr. 3. Alt. S., offered 1983. Prez. 426, 452. The civil engineer's role in the public works arena; the legal, ethical, and public works responsibilities in planning, financing, and in administering design, construction, operation, and maintenance of all public works projects.


522. Water Pollution Control Plant Design. (1-3) Cr. 2. S. Prez. 326, 426. Design and construction of physical, chemical and biological treatment processes, plant layout and hydraulic considerations.


554. Limit Analysis and Design. (3-0) Cr. 3. S. Prez. 333. Plastic analysis and design of steel beams and frames. Limit analysis and design for reinforced concrete beam and frame members. Design of structures with consideration of ultimate loads and deflections by mechanism procedures. Considerations of hinging, ductility, and minimum cost design criteria.

566. Advanced Structural Design in Metals. (3-0) Cr. 3. S. Prez. 333. Design of built-up beams, plate girders, and heavy connections. Study of the theories of behavior of structural metal members and the interpretation of specifications for the design of bridges and buildings.


570. Reinforced Concrete Design II. (2-2) Cr. 3. F. Prez. 334. Design of long columns, floor slabs, building frames, and beams. Design considerations for torsion, biaxial bending, and structural improvements. Introduction to cold-formed composite structures. Shrinkage and creep.


552. Traffic Engineering. (3-4) Cr. 3. F. Prez. 351. Driver, pedestrian and vehicular characteristics. Traffic characteristics, highway capacity; traffic studies and analyses. Principles of traffic engineering for traffic safety. Traffic signs, signals, and markings, lighting, channelization; other traffic control measures.

556. Airport Planning and Design. (2-3) Cr. 3. F. Prez. Consideration of design of airport runways and taxiways, including financing, traffic forecasts, site selection, zoning, operation of landing and terminal areas. Drainage; geometric and structural design of runways, taxiways, and aprons.

557. Transportation Analysis and Forecasting. (2-3) Cr. 3. F. Prez. 451, Stat 331 or 401 or 446. Travel studies and analysis of data. Travel projections. Public transportation forecasts and analyses.


563. Advanced Soil Engineering Laboratory. (2-3) Cr. 3. S. Prez. 565. Analysis of soils and civil engineering materials by X-ray diffraction, differential thermal, thermoplastic and electrical properties methods.

564. Advanced Soil Engineering Laboratory. (1-6) Cr. 3. S. Prez. 560. Triaxial shear, consolidation, permeability, capillary testing and analyses; relation of hydrostatic excess pressures to compositional influences. Field load tests.

565. Soil Behavior. (2-3) Cr. 3. F. Prez. 390. Physico-chemical factors affecting soil stability, clay minerals, clay colloids chemistry and effects of chemical additives; behavior of soils in special environmental systems. Determination of colloidal properties such as exchange capacity, zeta potential, capillarity and pore shape and size distribution.


578. Surface Water Hydrology. (2-3) Cr. 3. F. Prez. 371. Collection and analysis of hydrologic data concerning precipitation, infiltration, evapotranspiration, direct runoff and streamflow, theory and use of frequency analysis to hydrologic data, deterministic and statistical hydrologic models.

579. Water Resources Systems Engineering. (3-0) Cr. 3. Alt. F., offered 1982. Prez. 371, E 312. Analysis of systems, including mathematical formulations, research techniques to the planning, design, and operation of water resources systems; use of linear programming, network analysis, dynamic programming, and simulation as tools in solving water resources problems, use of deterministic and stochastic models in water resources planning and design.

580. Water Resources Systems Engineering. (3-0) Cr. 3. Alt. F., offered 1982. Prez. 371, E 312. Analysis of systems, including mathematical formulations, research techniques to the planning, design, and operation of water resources systems; use of linear programming, network analysis, dynamic programming, and simulation as tools in solving water resources problems, use of deterministic and stochastic models in water resources planning and design.

581. Ground Water Hydrology. (2-3) Cr. 3. S. Prez. 371. Water quality as related to ground-water, industrial, and agricultural water supplies, legislation, occurrence, hydraulics of flow; determination of aquifer and well characteristics, pumping and recharge, and impact of heavy metal removal and ground water basin management.

582. Multiple use of Water Resources. (2-0) Cr. 2. F. Prez. 371. Social, economic, and technical phases of governmental participation in public works programs in the field of water resources; study of planning and design of multiple purpose water resources projects.
578. Water Resources II. (W Res 578) See Water Resources.

585. Highway Construction Methods. (2-0) Cr. 2. F. Prereq. 362, 485. Methods and equipment used in processing materials and constructing highways and their apportionments; scheduling and controlling operations; specifications.

586. Heavy Construction Method. (2-0) Cr. 2. S. Prereq. 485. Methods and equipment employed in heavy construction including piles, 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 F.S. Preclassification contract required.

Courses for Graduate Students, major or minor

616. Advanced Topics in Photogrammetry, Remote Sensing, and Image Interpretation. (2-0) Cr. 2 each time taken, maximum 6 credits. S. Prereq. 510. Study of advanced concepts in photogrammetry, remote sensing, and image interpretation, including satellite applications. Projecting systems. Advanced topics in data reduction and image processing.

618. Advanced Topics in Geodesy. (2-0) Cr. 2 each time taken, maximum 6 credits. S. Prereq. 515. Study of advanced concepts in geodesy, including satellite applications, geodesy, including statistical methods. Advanced computational methods.


649. Advanced Topics in Structural Engineering. (3-0) Cr. 3. F. S. Prereq. Permission of structural graduate faculty. Advanced concepts in structural engineering topics. Emphasis for a particular offering will be selected from the following topics: A. Behavior of Metal Structures, B. Design of Concrete Shells, C. Cable-Supported Structures, D. Advanced Matrix Analysis of Structures. E. Dynamic Design of Structures.


660. Foundations and Underground Structures. (3-0) Cr. 3. S. S. Prereq. 560. Location, selection of materials, design, and construction of earth dams. Fee for field trip.


690. Advanced Topics. Cr. 1 to 3. Preclassification contract required.

699. Research.

*An undergraduate student must have an academic standing in upper one-half of his/her class in order to enroll in any 500-level civil engineering course.

Construction Engineering

Administered by the Department of Civil Engineering

John G. Russo, Professor in Charge

Courses are offered for minor work to students taking major work in other curricula or in interdepartmental programs.

Courses for Graduate Students, minor only


371. Construction Organization and Management. (3-0) Cr. 3. F.S. Prereq. 245. Construction company, organization, operation, and administration. Proper utilization and direction of manpower at the field and office levels. Interfunctional processes necessary for efficient communication and resolution of field and office construction related problems.


Courses Primarily for Graduate Students, major or minor, open to qualified undergraduates


570. Marketing Construction Services. (2-0) Cr. 2. F. Prereq. 371. Specific functions involved in marketing construction services. Need for construction marketing: market area and research, planning and objectives, operations, and personnel. Areas of image, publicity, job site arrangement, and promotional activity. Analysis techniques and analysis of existing construction company marketing systems.

590. Special Topics. Cr. 2 to 5 each time elected. F.S.S. Prereq. Permission of professor in charge. Study and report preparation in selected areas of construction materials, equipment, operations, planning and scheduling, and management.

Community and Regional Planning

Riad G. Mayahni, Chair of Department

The Graduate Faculty

Members: Brooks, Mayahni
Associate Members: Knox, Lex, Malone

The department offers work for the degree Master of Community and Regional Planning with major in community and regional planning. Degree requirements include completion of a 2-year, 52-credit program, including a thesis of 9 credits. Minor work is offered to students taking major work in other departments.

The program of graduate study is recognized by the American Planning Association. By taking work in community and regional planning and by focusing on an area of concentration, a student may develop a program with his or her selection of a special emphasis from administration, economic planning, environmental planning, transportation planning, urban design, housing and neighborhood renewal, policy analysis, state and regional planning, social planning, and planning in developing countries.

The degree master of community and regional planning, 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 (9 credits) are required for the M.C.R.P. degree. In addition, the student is encouraged to complete 3 months of acceptable work experience in a planning office between his or her first and second year.

The department participates in the interdepartmental minor programs in Housing, Transportation Planning, and Technology and Social Change. (See Index.)

Courses for Graduate Students, minor only

380. Regional Planning and Metropolitan Development. (3-0) Cr. 3. F. S. Prereq. 240. Analysis of the growth and changes occurring in non-metropolitan and metropolitan regions; theories and functions of area-wide planning governance structures, policies and strategies for guiding development.

405. New Towns and Planned Communities. (3-0) Cr. 3. S. S. Prereq. 253 or 270. Survey of new town and planned community experience in the United States and abroad. Goals, objectives, and policy implications of new towns; various types of new towns and their social, economic, and governance structures. Review of appropriate legislation.

406. State Planning. (3-0) Cr. 3. F. S. Prereq. 253 or 270, permission of instructor. The state planning process; definitions, state policies, interrelationship of state, regional, and local policies; current practices; location of the planning function; obstacles to state planning.

416. Urban Design and Planning Practice. (3-0) Cr. 3. S. S. Prereq. 272, permission of instructor. Principles of urban design and their application to residential and commercial development.

432. Urban Development Planning and Programming. (1-9) Cr. 4. S. S. Prereq. 272. Utilization of the comprehensive planning process. Preparation of selected affecting devices for the plans produced such as community revitalization projects, codes and ordinances, and capital improvement programming. Simulation of methods of analysis as applied to a specific geographic area.
492. Planning Law, Administration and Implementation. (3-0) Cr. 3. Prereq: 253 or 270. The basis in constitutional, administrative, and statutory law for the powers of plan effectuation. Problems of balancing public and private interests as revealed in the study of leading court cases, and the administration of planning agencies and programs.

493. Environmental Law. (3-0) Cr. 3. S. Prereq: 492. Legal prece dents, developments, and alternative policy approaches to protection, control, and development of the environmental rights, policies, regulations, and technology to land use and to water, air, and land pollution. Federal environmental control acts and leading federal court cases.

Courses Primarily for Graduate Students, major or minor, open to qualified undergraduates


511. Introduction to Community Planning. (3-0) Cr. 3. F. Social Planning of instructor. Development of planning in the United States; history and evolution of the planning profession and constructs of current practice.

512. Planning Communication. (2-0) Cr. 2. F. Prereq: Permission of instructor. Methods of graphic, print, and media presentation for the planning professional with emphasis on technical report writing and presentation skills.

515. Housing and Public Policy. (3-0) Cr. 3. S. Prereq: Permission of instructor. Housing as an interdisciplinary issue: the economic, political, social, and physical restraints on housing and community development policy.

520. Planning Methods. (3-0) Cr. 3. F. Prereq: 272 or graduate classification. Basic foundation of planning methods and analytical techniques. Planning information sources and their use in the analysis of community issues. Application of scientific method to forecasting of demographic and land use variables.

522. Advanced Planning Methods. (3-0) Cr. 3. S. Prereq: 272 or graduate classification. Advanced foundations of planning methods and techniques. Analysis of economic base, input-output analysis, employment forecasting, transportation, use of computers and models in planning.

524. Historic Preservation Planning. (3-0) Cr. 3. F. Prereq: Permission of instructor. Planning methodology employed to further preservation objectives. Zoning, transfer of development rights, and other preservation plans, public and private financing of preservation.

527. Urban Social Planning. (3-0) Cr. 3. S. Prereq: Permission of instructor. Review and development of methodologies, planning and implementation, and public and private service delivery systems, Federal, state, and local approaches to social policy and planning.

529. Planning in Developing Countries. (3-0) Cr. 3. S. Prereq: Permission of instructor. Integration of planning and related issues including urban-rural migration, development of national policies and programs, urban decay, rural development strategies, housing problems in a developing country.


561. Seminar in Planning Theory. (3-0) Cr. 3. S. Prereq: Permission of instructor. Current planning theories: competitive land use, advocacy, participatory, radical, and transactional planning models. Decision making and organization model as they affect planning practice. Value conflicts and conflict resolution.

575. Urban Planning/Urban Management. (3-0) Cr. 3. S. Prereq: Permission of instructor. The role planning plays as a part of the management and decision-making process, policy initiation, development, and implementation; management approaches and tools.


592. Planning Law, Administration and Effectuation. (3-0) Cr. 3. F. Prereq: Graduate classification in community and regional planning. Process of administration and implementation of planning programs through planning law. Effective management of the urban environment. Powers and duties of planning authorities and the powers of plan effectuation; problems of balancing public and private interest as revealed in study of leading court cases.

Courses for Graduate Students, major or minor

699. Research. Cr. var. F, S, SS.

Computer Science

Robert M. Stewart, Jr., Chair of Department

The Graduate Faculty

Members: Kafura, Keller, Lambert, Maple, Oldehoeft, Selman, Stewart, Zingg

Associate Members: Brealey, Eckstein, Grosvenor, Krishnaswamy, Strawn, Wright

The department offers work for the degrees Master of Science and Doctor of Philosophy with a major in computer science and minor work to students majoring in other departments.

Facilities exist for fundamental research in such areas as programming languages, computer architecture, operating systems, information structures and theoretical foundations.

A student desiring to do graduate work with a major in computer science should ideally have completed a bachelor's degree or equivalent in computer science. Students with a major in a related area such as electrical engineering or mathematics are also encouraged to apply.

For the degree Master of Science, 31 semester credits are required. Both thesis and non-thesis options are available. If a thesis is elected, the preparation of a paper demonstrating ability to organize and express significant ideas in computer science is required.

For the degree Doctor of Philosophy, a student is expected to demonstrate a high degree of proficiency in reading, writing and speaking skills. To insure such skills, the student must include in his program of study a demonstrated proficiency in either a foreign language or in communication skills.

All graduate students are required to pass a series of area examinations over the core areas of the graduate course offerings. The examinations are normally scheduled within the first two years of a student's graduate program.

The Department of Computer Science participates in the interdepartmental program Technology and Social Change. Students majoring in computer science may elect a minor in Technology and Social Change.

The Department of Computer Science recommends that all graduate students majoring in computer science teach as part of their training for an advanced degree.

Courses for Graduate Students, minor only

311. Data Structures and Algorithm Analysis. (3-0) Cr. 3. S. Prereq: 211, 280. Basic techniques for design and analysis of efficient algorithms; sorting, graph processing, and memory management algorithms. The investigation of a simple data base management system will provide an applications environment for topics discussed in this course.

332. Principles of Programming Languages. (3-0) Cr. 3. F. Prereq: 211. Organization of programming languages emphasizing their run time implementation. Introduction to several modern programming languages. Programming in several languages.

352. Introduction to Operating Systems. (3-0) Cr. 3. S. Prereq: 211, 218 E 384. Survey of operating system issues. Introduction to hardware and software components including: processors, peripherals, interrupts, process and memory management, deadlocks, file systems, protection, virtual machines and system organization.

375. Applied Information Processing Systems. (3-0) Cr. 3. S. Prereq: 111 or 175 and knowledge of COBOL. Computer-oriented information systems concepts; introduction to systems analysis; working with a job control language, applying access methods and introduction to data base systems; batch and interactive projects using a business language.

411. Software Engineering. (2-2) Cr. 3. S. Prereq: 311. Principles and techniques for methodical construction of quality software. Software requirements and objectives; reliability; design methodologies; module specification techniques; testing and validation procedures; proof of program correctness. Emphasis on team projects.

432. Principles of Compiling. (3-0) Cr. 3. S. Prereq: 260, 332. Techniques of compiler and interpreter construction are studied. Lexical analysis, modern top-down and bottom-up parsing techniques, syntax directed translation, and code generation.

441. Computer Based Information Systems. (3-0) Cr. 3. F. Prereq: 311, 352. Advanced file concepts and access methods; data base management systems concepts and implementation; data dictionary structures; computer systems concepts for supporting data base systems; language considerations; computer center organizational structures; computer center information system project.

452. Implementation of Operating Systems. (2-2) Cr. 3. F. Prereq: 352. Laboratory course emphasizing the practical issues of operating systems design and implementation. Source code for a hierarchically structured system. Additions, replacements, or extensions to the system will be required as an individual or team project.

470. Computing Methods for Research Workers. (3-0) Cr. 3. S. Prereq: 111 or 172 or 175 or graduate classification and one course in college level mathematics or computer science. A variety of languages available for research. Use of utilities, command languages and files in research projects.

Courses Primarily for Graduate Students, major or minor, open to qualified undergraduates


Courses for Graduate Students, major or minor

426. Criticism of Design. (3-0) Cr. 3. F.S. Prereq: Arch 321 or Art 280 or CRP 383 or LA 271. Developing and exercising a process of critical evaluation of designed objects varying in size and complexity.

490. Independent Study. Cr. 2 to 4 each time taken. Prereq: Permission of instructor; advance registration. Investigation of an approved topic commensurate with the student’s interest and ability. H. Honors.

580. Advanced Interdisciplinary Studies. Cr. 2 to 5 each time taken. Prereq: Permission of instructors. An interdisciplinary approach to the examination of a topical issue of interest to the College of Design. Faculty from more than one discipline.

Geography (Geog)

Courses for Graduate Students, major only

324. Cultural Geography. (2-0) Cr. F. Rahman. Prereq: 3 credits in geography. Origin, distribution and influence of cultural processes such as discovery, invention, evolution, and diffusion of phenomena on the landscape.

490. Independent Study. Cr. 2 to 4 each time taken. Prereq: 2 credits in geography.

495. Summer Field Study. Cr. 4 to 6. SS. Prereq: 4 credits in geography, permission of instructor. Correlated readings and field work. Four to six week field trip to a selected region in the U.S. or abroad to study cultural or physical geographic relationships. Written report required.

Geology (Geol)

Courses for Graduate Students, minor only

302A. Summer Field Studies. Cr. 6 to 8. SS. Prereq: 231, 241, 355, Vondra. 302A: Areal mapping, structural, stratigraphic, and geomorphologic analyses. Written reports with appropriate illustrations required. An 8-week summer field course required of all geology majors. Fee.


355. Structural Geology. (2-4) Cr. 4. S. Prereq: 100 or 210, Phys 111 or 221 (preferred), Math 175. Lernish. Description and classification of structures in sedimentary, metamorphic, and igneous rocks. Introduction to mechanical principles as related to deformational structures. Use of rock bodies in different environments. Laboratory includes application of geometrical techniques to solve structural problems; emphasizes map interpretation and use of stereonet. Fee.


380. Introduction to Geophysics. (3-0) Cr. 3. F. Prereq: 302A, Phys 112 or 222 (preferred). Sayre. Application of physical principles to determination of subsurface rock structure or boundaries or both. Includes seismology, gravimetry, magnetometry, and techniques of electrical and radioactivity surveying. Field application of geophysical methods to include data acquisition, computer processing and interpretation. Fee.


484. Remote Sensing for Environmental Analysis. (Geog 484L) (2-0) Cr. 2. Alt. F. Prereq: 100, 210, or 301 or Geog 100 or 202, concurrent enrollment in Geol 484L. Principles of remote sensing; interpretation of land patterns based on their physical, geologic, biologic, and cultural images.

484L. Remote Sensing Laboratory. (0-2) Cr. 1. Alt. F. Prereq: Concurrent enrollment in Geol 484L. Geomorphic, lithologic, and structural interpretation of remote sensing data.
Each student is expected to achieve a minimum competency in economic theory as demonstrated by completing basic and advanced courses in microeconomic and macroeconomic theory and by completing a written examination. Examinations are also required in two other fields selected from the list above. An outside minor, such as statistics, mathematics, or computer science, can be substituted for one of the fields.

Cooperative programs of study may be arranged with the University of Iowa College of Law or with other recognized institutions.

The department also cooperates in the interdepartmental programs of Industrial Administration, Industrial Relations, Technology and Social Change, Transportation Planning, and Water Resources. (See Index.)

Courses for Graduate Students, minor only

401. Prices and Resource Allocation. (4-0) Cr. 4. F.S. SS. Prereq: 201 or 204. Theory of consumer demand and supply behavior of the business firm; competitive and imperfectly competitive markets. Theory of the demand for and supply of labor. General equilibrium analysis and welfare economics.


404. Labor Economics. (3-0) Cr. 3. F.S.S. SS. Prereq: 201 or 204. Survey of contemporary labor market problems and public policy toward labor. Economic analysis of topics such as labor supply and hours of work, incentives of transfer programs, education and training, mobility, labor demand and employment, minimum wages, unions, income distribution and relative wages, discrimination in wages and labor inflations, social insurance, and unemployment.

405. Public Finance. (3-0) Cr. 3. F.S.S. SS. Prereq: 201 or 204. Economics of public expenditures and taxation: federal, state, and local revenue and expenditure policies; current issues in public finance.

406. Macroeconomics. (3-0) Cr. 3. F.S. Prereq: 201 or 204. Economic theories of Karl Marx, including contributions and criticisms by other scholars. Topics include value, price, and distribution theory; business cycles, supply of labor, and evolution of economic systems; applications to contemporary economies, including developing nations.

410. Economics of Antitrust and Regulation. (3-0) Cr. 3. S. SS. Preq: 201 or 204. Analysis of the antitrust laws and regulation of industries. Analysis of antitrust laws and government regulation of industries.

411: Economic Development. (3-0) Cr. 3. F. S. Preq: 201 or 204. Current problems of developing countries, theories of economic development, agriculture and economic development, measurement and prediction of economic performance of developing countries, alternative policies and systems required for satisfying basic needs of third world countries, international cooperation between industrialized countries and the developing countries.

421. Cooperative Economics. (2-0) Cr. 2. Alt. F. offered 1961 Prereq: 201 or 204. General survey of cooperative activities, with special reference to agriculture, kinds of cooperatives, methods of organization and operation; principles, legal regulation, and economic possibilities and limitations of cooperation.


435. Agricultural Finance and Investment Analysis. (4-0) Cr. 4. F.S. Preq: 201 or 204. Financial requirements of farm firms. Acquisition of debt and equity funds. Investment and cash flow analysis. Evaluation of credit needs and repayment capacity.

Appraisal and valuation of real estate. Analysis of credit sources including commercial banks, insurance companies, merchants and dealers, Farm Credit System banks, Farmers Home Administration, Small Business Administration, and individuals.


446. Economics of Discrimination. (WS 446) (2-0) Cr. 2. F. S. Preq: 201 or 204. Economic theories of discrimination. Analysis of the economic problems of women and minorities in such areas as earnings, occupations, and unemployment. Public policy concerning discrimination.

447. Agricultural and Rural Policy. (3-0) Cr. 3. F.S. Preq: 201 or 204. Description and analysis of economic problems of agriculture and rural communities. Explanation and economic analysis of government programs to develop agriculture and rural communities, stabilize and improve farm prices and incomes, plan rural land use, industrialize rural areas, control agricultural pollution, alleviate rural poverty, and regulate foreign trade.

451. Agricultural Law. (3-2) Cr. 4. F. S. Preq: Senior classification. The legal framework upon which decision making by firms and individuals: real and personal property. organization of farm firms, interdependence of transfer, trusts, insurance, liabilties, contracts, secured transactions, negotiable instruments, tax planning and management, water law, environmental law, federal and state regulatory powers.

455. International Economics. (4-0) Cr. 4. F.S. Preq: 201 or 204. Analysis of patterns and benefits of international trade in relationship to employment, factor prices, and growth. International cartels, monopolies, and governmental policies toward trade, such as tariffs, quotas, and common markets. Balance of payments, deficit, surplus, and exchange rate policies. Analysis of devaluations, international role of gold, Special Drawing Rights (SDR), fixed versus flexible exchange rates, history and reform of the international monetary system.

461. Urban and Regional Economics. (3-0) Cr. 3. F.S. Preq: 201 or 204. Theories of urban development, city typologies, transport cost patterns; urban economic interdependence; social investment in metropolitan communities, regional growth and efficiency, local determinants of firms and households, the regional economic base: resource development and economic planning in the city-region.

465. Economics of Educational Systems. (3-0) Cr. 3. Alt. S. offered 1982. SS. Preq: 201 or 204. Economic problems of public education and training of services, resource use, allocative techniques among and within school systems, alternative measures of educational value, resource development through social systems.


"Administered by the College of Agriculture, courses not marked are not administered by the College of Sciences and Humanities.

Courses for Undergraduates, minor only

500. Introduction to Graduate Studies. (1-0) Cr. R. F. Orientation course for graduate students. Course content, ongoing research, and job opportunities in different areas of specialization in economics are discussed by the graduate faculty.


512. Agrarian Reform and Economic Development. (3-0) Cr. 3. Alt. S. offered 1983. Preq: 501. Nature of agrarian institutions in obstructing and in achieving economic growth, income distribution and employment within developing countries, factors in factor markets, the role of money and product markets, credit, ownership, and foreign systems, labor arrangements, inheritance and land, water rights, land and labor problem, and other agrarian institutions through countries, regional, intercountry, and United Nations actions. Comparative analysis of these institutions within countries, and adaptation to other countries.


516. Economic Aspects of Antitrust and Trade Regulation. (3-0) Cr. 3. Alt. S. offered 1983. Preq: 501. Legal manifestations of national economic antitrust and trade regulation with emphasis on the role of government in industrial organization and price output policy; exemptions from antitrust law; price control; market divergences 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.

520. Human Capital Formation in Rural Areas. (3-0) Cr. 3. Alt. S. offered 1983. Preq: 501. Nature and process of human capital formation in households, firms and public institutions, time allocation in industrial organization and price output policy; exemptions from antitrust law; price control; market divergences 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.

530. Applications of Mathematical Programming in Agriculture. (2-0) Cr. 2. F. S. Preq: 430. Techniques of building and solving linear programming models of agricultural problems, model building, solving problems with MPSX, and interpreting the solutions. Applications of interregional competition models and multiplex, integer, separable, and quadratic programming procedures.

531. Agricultural Marketing Principles. (3-0) Cr. 3. F. S. Preq: Credit or classification in 501. Marketing firm choices concerning input acquisition, production, marketing, and distribution. Implications of marketing and pricing strategies on impacts of market structures, information, grading, alternative coordination and ownership arrangements, futures markets, government regulation.

540. Quantitative Research and Decision Models. (3-0) Cr. 3. S. S. Preq: 201 or 204. Concentration in Stat 401. Use of statistical, economic, and other social science models to study marketing problems. Applications to public and private decision making and policies.

555. Economic Development and Transformation of Agriculture in Developing Countries. (3-0) Cr. 3. Alt. S. offered 1982. Preq: 501. Role of agriculture in economic development, relation of agricultural development to factor prices, firm structure and technology; role of government policies, firm behavior, and aggregate food response; improvement and communication of technology; capital supplies;
resource problems under various developmental stages; equity problems.

536. Dynamic Economic Analysis. (3-0) Cr. 3. S. Prereq: 501, 503. Fundamentals of dynamic economic theory; difference and differential equations; stability; optimum solutions; dynamic modeling; policy analysis, with emphasis on applications to macro and microeconomic theory, equilibrium and disequilibrium systems. Dynamic optimization techniques and applications to economic theory.

537. Linear and Nonlinear Economic Models. (3-0) Cr. 3. S. Prereq: 401, 504. Linear and nonlinear programming, input-output analysis, game theory, Markov chains, population growth and other applied mathematical models in economics.


545. Economics of Taxation. (3-0) Cr. 3. S. Prereq: 501. Partial and general equilibrium analysis of tax shifting and incidence, excess burden and effects of taxes on supplies of labor, capital, and risk-taking, alternative bases for taxation, the impact of taxes on equity, optimal taxation: economic effects of personal and corporate income taxes, payroll taxes, sales taxes, wealth and property taxes; the burden of debt, fiscal federalism.


551. Monetary Theory. (3-0) Cr. 3. F. Prereq: 503. The monetary mechanism: neoclassical theory, neo-Keynesian monetary theory and the portfolio approach; microeconomic aspects of monetary theory, including money disequilibrium, 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. S. Prereq: 501. Analysis of the cost of money, the nature and process of money creation, the national money supply, monetary aggregates, and money demand.

555. International Trade. (3-0) Cr. 3. F. Prereq: 501. Modern theory of international trade; welfare and distributional aspects of trade and tariffs. The interdependence of trade and economic growth. Optimal trade policies in the presence of such distortions as unemployment, monopolies and cartels, balance of payments problems, infant industries, and common market areas.

557. International Finance. (3-0) Cr. 3. S. Prereq: 503. Theory of foreign exchange; mechanisms of adjustment to balance of payments problems such as devaluations, monetary and fiscal exchange controls, international dependencies between domestic economies. Exchange speculation, evolution of the international monetary system, capital movements, the phenomenon of international inflation.


562. Agricultural and Food Policies and Programs. (3-0) Cr. 3. S. Prereq: 567. Analysis of agricultural and food policies and programs influencing agricultural resource productivity and allocation, farm product, food and input prices, income distribution, food situation, international trade in agricultural commodities.


568. Evaluation of Development Projects. (3-0) Cr. 3. Alt. S.; offered 1983. Prereq: 501. Review of standards for the planning and evaluation of natural resource and related development projects: traditional practices and recent innovations; economic and financial analysis; traditional investment criteria, project selection and investment programs, investment criteria for economic development; determination of the discount rate, relation between classical welfare economics and cost-benefit analysis. Application of economic analysis, secondary benefits and intangibles, traditional approaches to the valuation of labor, capital and foreign exchange; models of optimal economic growth and determination of national economic parameters. Integration of efficiency and equity into project selection, derivation and estimation of shadow prices; relationship between planning and programming and the analysis of development projects.

573. Applied Econometric Models. (4-0) Cr. 4. F. Prereq: Stat 405. Selected applications of econometric techniques to models of consumer behavior; cost and production, demand for factors of production, the financial sector, and macroeconomic models. Selected topics of econometric problems encountered in applied econometric research.

575. Bayesian Econometrics. (3-0) Cr. 3. F. Offered twice every three years, offered 1981 Prereq: Stat 447. Difficulties with orthodox procedures, foundations of Bayesian inference, parameter estimation and forecasting, Bayesian hypothesis testing, regression models, simultaneous equations. Bayesian control models.


590. Special Topics. Cr. 1 to 5 each time taken. 1A. Agriculture Economics B. Economics

595. Law of Labor Relations. (3-0) Cr. 3. F. Prereq: See 445. Federal and state legislation and policies affecting the collective bargaining process, wages, and employment.


*Administered by the College of Agriculture. Courses not marked by an asterisk are administered by the College of Sciences and Humanities.

Courses for Graduate Students, major or minor

601. Advanced Microeconomic Analysis. (3-0) Cr. 3. S. F. Prereq: 501. Advanced topics in consumer theory; compensating and equivalent variations, indirect utility function, theory of the second best, interim resource allocation, consumer and producer behavior.


641. Economics of Agricultural Production and Resource Allocation. (4-0) Cr. 4. S. Prereq: 501. Production principles applied to agricultural labor, capital and natural resources; uncertainty and decision models; farm size, cost and productivity, commodity supply and resource demand, location and interregional competition, programming, simulation and other planning models, technological change, efficiency of agricultural production, macro and policy aspects.


690. Seminar. Cr. 1 to 3 each time taken. Prereq: 6 graduate credits in related field. Offerings each semester will be selected from the following list.

A. Industrial Organization
B. International Economics
C. Economic Development
D. Monetary Economics
E. Public Finance
F. Urban Regional Economics
G. Agricultural Marketing and Price Analysis
H. Agricultural Development
I. Labor Economics


*Administered by the College of Agriculture. Courses not marked by an asterisk are administered by the College of Sciences and Humanities.
**Electrical Engineering**

J. O. Kopplin, Chair of Department

The Graduate Faculty

Members: Basart, Boast (Emeritus), Brockman, Brown, Fanslow, Fouad, Hale, Hsieh, Koerber, Kopplin, Land, Michalowski, Mohan, Post, Read, Smy, Swift, Thowsen, Zingg

Associate Members: Bond, Brearley, Burns, Camp, Carlson, Coady, Comstock, Day, Horton, Jones, Kruepelm, Marandun, Mericle, Musil, Nilsson, Piatkowski, Potter, Samuels, Scott, Stephenson, Townsend, Triska, Willett

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 a wide range of courses outside the Electrical Engineering Department. The department also participates in the Technology and Social Change and Energy Systems Engineering interdepartmental minors.

The degree Master of Science requires a thesis and is recommended for students who intend to continue toward the Doctor of Philosophy degree or to undertake a career in research and development. The non-thesis Master of Engineering degree requires an independent study project. Students pursuing a Doctor of Philosophy degree must select one of the following areas of specialization: electromagnetic, computer engineering, control systems, and electric power.

The normal prerequisite to major graduate work in electrical engineering is the completion of undergraduate work substantially equivalent to that required of electrical or computer 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 certain areas of electrical engineering 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 electrical engineering is urged to submit, with the application for admission, a statement of the proposed area of graduate study.

The department requires submission of GRE aptitude test scores by applicants from other countries. All students whose first language is not English must submit TOEFL examination scores.

Interdisciplinary programs between electrical engineering and biomedical engineering are provided jointly under sponsorship by the College of Biomedical Engineering and the College of Veterinary Medicine. Laboratory facilities are available at the College of Veterinary Medicine, South Campus. (See Biomedical Engineering.)

**Courses for Graduate Students, minor only**


352. Electromagnetic Devices and Electric Machinery Laboratory. (0-3) Cr. 1. F.S. Prereq: Credit or classification in 313. Experiment with electric and magnetic devices: force and torque measurements; transformers and their equivalent circuits, electric rotating machines, and the digital and solid state control of motors.


423. Communication Systems Laboratory. (0-3) Cr. 1. F. Prereq: 421. Credit or classification in 421. Construction and evaluation of modulators, demodulators, and other components for communication systems. Design and evaluation of a simple communication system.


451. Electrical Energy Sources. (2-0) Cr. 2. S. Prereq: Senior classification in engineering. A study of direct energy conversion devices and electrical energy storage methods with emphasis on their utilization in solar electric systems.

456. Power System Analysis I. (3-0) Cr. 3. F. Prereq: Credit or classification in 315. Power transmission lines, network analysis, power system representation, load flow.


Courses Primarily for Graduate Students, major or minor, open to qualified undergraduates


510. Topics in Electromagnetics. Cr. 1 to 3. F.S. Prereq: Permission of instructor.

A. Antennas

B. Electromagnetic theory

C. Microwave engineering

D. Radio astronomy

E. Contemporary topics

511. Modern Engineering Optics. (3-0) Cr. 3 each topic. Prereq: 411. Each topic for primary emphasis will be on one of the following topics:

A. Stimulated emission devices and systems: masers, lasers, and applications.

B. Fourier optics and photography

C. Optical and hybrid optical-digital computers


552. Advanced Microcomputer Design. (3-0) Cr. 3. Prereq: Cpr E 487. A study of microcomputer systems design, including both hardware and software details associated with currently available off-the-shelf microprocessors.

556. Advanced Digital Signal Architecture. (3-0) Cr. 3. Prereq: Cpr E 485 or Com S 501. Innovations in the architecture and implementation of computer systems. Impact of technology on computer architecture. Trade-offs in the implementation of computer systems.


Courses for Graduate Students, major or minor

610. Advanced Topics in Electromagnetics. (3-0) Cr. 3. Each time elected. F. S. Prereq: Permission of instructor.

Antennas
Electromagnetic theory
Microwave engineering
Radio astronomy


653. Advanced Topics in Electric Power Engineering. (3-0) Cr. 3. Each time elected. Prereq: Permission of instructor. Advanced topics of current interest in electric power system engineering.

Prime power generation
System planning
System dynamics
Rehabilitation methods
Control and operation
Power electronics
Energy conversion
DC transmission systems
Lightning and switching devices

Advanced Topics in Systems Engineering. (3-0) Cr. 3. Each time elected. Prereq: Permission of instructor.


482. Digital Systems Design Laboratory II. (1-2) Cr. 2. S. Prereq: 481. Projects in digital system design. Fee.


487. Introduction to Microprocessors. (3-3) Cr. 4. F. Prereq: 384, E E 436 or 437. Introduction to microprocessors. Microprocessor architecture and associated microcomputer systems. Consideration of peripheral systems and hardware/software tradeoffs. Software examples. Top-down designs are explored in a variety of examples.


541. Teaching Strategies for Learning Disabilities. (3-0) Cr. 3. Prereq: 455 or 540. Analysis of techniques and materials for remedying specific learning disabilities.


593. Workshop. Cr. 1 to 5. SS. Prereq: 15 credits in education.

Courses for Graduate Students, major or minor

450. Ethnicity and Learning. (3-0) Cr. 3. Prereq: 345. Examination of the ethically different learner in the classroom setting, with emphasis on cultural relevance in instruction.

451. Ethnicity and Learning Practicum. (1-4) Cr. 3. Prereq: 450. Field experience in a multi-ethnic classroom setting, with seminar discussion of these experiences.

457. Teaching Exceptional Learners in the Regular Classroom. (3-0) Cr. 3. F.S.S. Prereq: 280. Emphasis on teaching techniques, teacher attitudes, and instructional modifications for mainstreaming exceptional learners (learning disabilities, emotional disabilities, mental disabilities, physically and perceptually handicapped, and gifted and talented children).

490. Evaluating Classroom Learning. (3-0) Cr. 3. Prereq: 375. Emphasis on application of both formal and informal achievement test data to classroom teaching practices.

Courses Primarily for Graduate Students, major or minor, open to qualified undergraduates

520. Teaching Strategies for Individualized Instruction. (2-0) Cr. 2. S.S. Prereq: 9 credits in behavioral sciences. Analysis of current trends and practices for individualization.

521. Gifted Children and the Elementary School. (3-0) Cr. 3. F. Prereq: 9 credits in education. Survey of major areas of concern in the field of teaching gifted children.

522. Principles of Corrective Reading. (2-0) Cr. 2. F.S.S. Prereq: 375. Identification, analysis, and correction of reading problems within the elementary program.

523. Principles of Corrective Mathematics. (2-0) Cr. 2. S.SS. Prereq: 446. Identification, analysis, and correction of mathematics problems within the elementary program.
The Graduate Faculty
The department offers work for the degrees work is required for the degree. The program is intended to give students additional instruction at the graduate level to better qualify them for advanced professional engineering work. By careful selection of electives and perhaps additional courses during the senior undergraduate year, students should be able to qualify for the master of engineering degree with an additional year of full-time study after receiving their baccalaureate degree in one of the several engineering curricula.

Credits for creative endeavor will be obtained by registering for E M 690M. The achievement will be determined by means of a written report and an oral presentation to the student’s graduate committee.

The normal prerequisite to major graduate work is the completion of a curriculum substantially equivalent to that required of undergraduate students in engineering at this University. However, because university interests in graduate work in engineering mechanics, it is possible for a student to qualify for graduate study even though undergraduate or prior graduate training has been in a discipline other than engineering.

Students minoring in energy systems engineering will select a block of courses from an approval list to achieve a stated energy-related objective. A member of the Energy Systems Engineering Supervisory Committee will serve on the student’s program of study committee and will assist in defining a suitable minor program. The approved list of courses is available from the chairman of the supervisory committee.

Usually a block of 8 hours will be required as a minor for the master’s degree and 12 hours as a minor for the doctoral degree. Energy Systems Engineering (E E , M E , Nu c E 543) shall be included in the student’s program. The remainder of courses should be selected from those offered in two majors other than the student’s major, at least one of which shall be outside the student’s department.

Courses for Graduate Students, minor only
301. Fundamentals of Mechanics. (4-0) Cr. 4. F.S.S. Preq: Ph y s 221, Math 166. Newton’s laws, equilibrium of rigid and deformable bodies, stress, Kinematics and dynamics of particles and rigid bodies. Deformation and strain of solids and fluids, constitutive equations for solids and Newtonian fluids. Applications to tension, torsion, flexure of solid bars and vibrations. E M 301 can not be used for credit toward graduation for students who have completed E M 324 or E M 345 or their equivalent.


437. Mechanical Engineering (M E 337) (2-3) Cr. 3. F.S.S. Preq: 301 or credit or classification in 324. Properties, uses, and manufacture of metals, timber, stone, glass, plastic materials, cements, concrete, and other engineering materials. Laboratory work similar to 327 with additional topics and added emphasis on computer.

435. Dynamics. (3-0) Cr. 3. F.S.S. Preq: 274. Credit or classification in Math 266 or 267. Particle and rigid body kinematics. Newton’s laws of motion, rigid body kinetics. Work-energy, linear and angular impulse-momentum, rotating coordinates, Coriolis acceleration. Applications to gyroscopic motions, impact and vibrations.


70L Nondestructive Testing Laboratory. (M E 370L) See Materials Science and Engineering.


425. Introduction to the Finite Element Method. (3-0) Cr. 3. S. Preq: 301 or 324, Math 266 or Math 267. Introduction to finite element analysis with applications to problems such as stress-deformation analysis, fluid and heat flow, potential flow, torsion, wave propagation. Use of simple codes for computer solution of problems.

446. Mechanical Vibrations. (2-2) Cr. 3. F.S. Preq: 324, 345, knowledge of FORTRAN. Elementary vibration analysis, single and multiple degrees of freedom, energy methods, free and forced vibrations, viscous damping, transmissibility, influence coefficients, matrix methods, lateral vibrations of beams. Selected laboratory experiments.

451. Engineering Acoustics. (M E 451) (2-2) Cr. 3. F.S. Preq: Phys 221 and Math 266 or 267. Sound sources and propagation. Noise standards and effects of noise on man. Theories of noise and application of control used in architectural and engineering design. Characteristics of basic noise measurement equipment. Experience in use of noise measuring equipment, sound power measurements, techniques for performing noise surveys, evaluation of various noise abatement techniques applied to common noise sources. Laboratory and field experiments.


*Students who are not present for the first laboratory meeting of some other section of either of these two courses.

Courses for Graduate Students, major only, open to qualified undergraduates


516. Applied Elasticity. (3-0) Cr. 3. S. Preq: 514. Basic a p p l i c a t i on of plane elasticity theory. Any stress function and Prandtl torsion function with applications. Virtual work, least work, and other energy methods.

517. Experimental Stress Analysis. (3-2) Cr. 4. S. Preq: 324. Fundamental concepts of strain measurement, properties of torsion and its ablation, wire, foil, and semiconductor strain gauges, strain gauge circuits and recording instruments, rosette analysis, and three-dimensional analysis. Compensation techniques, principal stress separation using shear difference, oblique incidence and other relationships concept of biaxial state. Stress concentration, fatigue and fracture. Design of experiments, moire methods, introduction to holography.

519. Experimental Methods of Motion Measurement. (2-2) Cr. 3. F. S. (301-417, 444). Description, specifications, limitations, and applications of mechanical, electrical, and optical transducers used in motion measurements applied to steady state, transient, and shock motions. Calibration, signal conditioning, and use of transducers to obtain reliable and reproducible experimental data. Seminar and absolute references for motion measurement.

520. Biomechanics. (B M E 520) Cr. 3. S. Preq: Phys 117 or Math 265. For students with interests in the life sciences who wish to obtain background in applied mechanics. Equilibrium, vibratory motion, stress and deformation, material properties, flow of fluids, dimensional analysis and modeling of biological systems. Examples taken from biology and medicine.
English

Frank E. Haggard, Chair of Department

The Graduate Faculty

Members: Benson, Bruner, Consiglio, P. G. Davies, Leonard Feinberg, Hermist, Huntress (Emeritus), Jumper, Nakadate, Poole, Siet, Walker (Emeritus), Yates


The department offers work for the Master of Arts degree with a major in English, and minor work for students majoring in other departments. The master's degree requires 30 semester credits, including a thesis (3 credits) or a major project (ordinarily 3 credits). Courses must include 530, 511 or 512, and usually 503. Basic knowledge of one foreign language must be demonstrated by test or course work. Toward the end of the program, each candidate writes an examination covering a major, author and a period or area in literature, linguistics, or other programs offered by the department agreed on by the candidate and the examining committee. Candidates admitted to major graduate work should take a completed undergraduate study substantially equivalent to that in the undergraduate program in English at Iowa State.

Individual graduate programs of study are designed to prepare students for (1) teaching at the secondary, two-year college, or beginning college and university level; (2) further graduate study in language and literature, and (3) teaching English as a second language. (4) creative writing, (5) technical writing, editing, and associated commercial writing activities.
The department participates in the interdepartmental program in Technology and Social Change (see Index) and provides practicum or similar experiences for English graduate students in the Writing Center, Reading Center, Intensive English and Orientation Program, Freshman English Program, and selected departmental research activities. Some financial assistance awards for graduate students are available.

Graduate students in English may include 495 in their major programs of study. Selected courses in English may be used to meet part of the requirements for certification to teach English in two-year and community colleges (see department information bulletin).

Courses for Graduate Student, minor only

315. Creative Writing — Screenplays. (3-0) Cr. 3 each time taken, maximum of 6. Prereq: 105, not open to freshmen. Stresses master scene technique of writing fully developed screenplays. Course may be repeated in conjunction with actual production of film or teleplay. Emphasis on TV and movie techniques, writing, workshop criticism, analytical reading and viewing, and individual conferences.

316. Creative Writing — Playwriting. (Sp 316) (3-0) Cr. 3. Prereq: 105 and permission of instructor. Preparation of a one-act play. Emphasis on action, staging, writing, analytical reading, workshop criticism, and individual conferences.

335. Film. (3-0) Cr. 3. F. S. Prereq: 105. Principles of film art and the traditional vocabulary of literature as applied to film. Influence of film on modes of thought and behavior. Fee.

345. Literature by or About Women. (W 345) (3-0) Cr. 3 each time taken, maximum of 6. Prereq: 105. Literature by and/or about American ethnic minorities. May include literary groups or focus upon one of the following: Asian Americans, Black Americans, Hispanic Americans, American Indians.

347. Survey of Black American Literature. (3-0) Cr. 3. S. Prereq: 105. Literature by Black Americans from the beginnings to the 1960's.

349. Selected Topics in Minority Literatures. (3-0) Cr. 3 each time taken, maximum of 6. F. Prereq: 105. Literature and by/and/through American ethnic minorities. May include literary groups or focus upon one of the following: Asian Americans, Black Americans, Hispanic Americans, American Indians.

357. Folk Literature and Myth. (3-0) Cr. 3. AY. Prereq: 105. Folk literature, its types and functions, in both sacred and profane traditions. Emphasis on traditional narratives (epic, legend, ballad, folk and fairy tale), myth, proverbs, and riddles.

366. Studies in Drama. (3-0) Cr. 3 each time taken, maximum of 6. Prereq: 105. Selected topics in the study of drama. Examination of major themes, genres, dramatists, and periods.

394. Literature of Adolescence. (3-0) Cr. 3. Prereq: 105. Literature and for about the adolescent. Critical study and evaluation of the genre; examination of major authors and themes found in the literature; study of the relationship of the genre to literature for children and adults. Selection of literature for use in school programs.

400. Studies in English. (3-0) Cr. 3 each time taken, maximum of 6. Prereq: 105. One 3-credit course in English, junior or senior class, by and about American ethnic minorities.

414. Writing of Professional Papers and Reports. (3-0) Cr. 3. F. SS. Prereq: 105, junior classification. Writing of business, technical, and professional papers and reports, including a major analytical report on a topic from the student's discipline.


495. Teaching English to Speakers of Other Languages: Methods and Materials. (3-0) Cr. 3. Prereq: 219 or an introductory course in linguistics. Teaching grammar, reading, writing, listening comprehension, speaking, and pronunciation. Testing and evaluation. Open to graduate students in English for major graduate credit.

Courses for Graduate Students, major or minor, open to qualified undergraduates

503. Teaching Composition: Approaches to Writing and Rhetoric. (3-0) Cr. 3 or 4. Prereq: Undergraduate major or certification to teach English. Current practices and problems in teaching composition at the secondary, junior college, and college levels. Preparation of assignments, evaluation of papers, syntactic and rhetorical analyses, theories of the composing process with applications.

504. Advanced Imaginative Writing. Cr. 1 to 3 each time taken, maximum of 9. Prereq: 404 and submission of portfolio to instructor well before the course begins. Individual projects on a workshop and conference basis.

505. Theory and Pedagogy of Reading. (3-0) Cr. 3. Prereq: 3 credits in linguistics, psycholinguistics, or language acquisition. Theoretical models and research developments in reading. Practice with standardized, informal, and diagnostic instruments for measurement of reading. Implications for teaching reading in secondary schools.

507. Professional and Occupational Writing. (3-0) Cr. 3. Prereq: 105, 219 or permission of instructor. Writing and analysis of documents prepared in business, science, and industry: reports, manuals, instructions, etc. Individual projects directed to training in writing for the specific jobs in which the student expects to work.

511. Introduction to General Linguistics. (3-0) Cr. 3 F., Alt. S. Prereq: 3 credits in linguistics. Principles of general linguistics, history of the development of modern linguistic scholarship.

512. Historical Linguistics and Language Classification. (3-0) Cr. 3. S. Alt. SS. Prereq: 3 credits in linguistics or in British literature before 1600. English historical linguistics. Genealogical and typological classification of languages.

514. Regional and Social Dialects of American English. (3-0) Cr. 3. Prereq: 105, 219, or workshop in American English. Regional dialects of American English. Theories and practical analysis of the sound systems of languages, with an emphasis on English phonology.

517. Theoretical Foundations for Teaching English to Speakers of Other Languages. (3-0) Cr. 3. Prereq: 511 or an introductory course in linguistics. Theoretical and practical analysis of the sound systems of languages, with an emphasis on English phonology.

518. (419 DL) English Syntax. (3-0) Cr. 3. Prereq: 3 credits in linguistics. Study of syntax in conjunction with English 419. May not be taken by students who have previously earned credit in English 419. Additional readings, term project, and special examination for students who enroll.

519. Theoretical Foundations for Teaching English to Speakers of Other Languages. (3-0) Cr. 3. Prereq: 511 or an introductory course in linguistics. Theoretical and practical analysis of the sound systems of languages, with an emphasis on English phonology.

521. Teaching Language and the Literature Curriculum. (3-0) Cr. 3. Prereq: 3 credits in literature. Study of the roles of the literary work, reader, and teacher in literary study. Responses to literature. Place of literature in language arts. Study of curriculum materials for varied levels of instruction.

522. Literary Criticism. (3-0) Cr. 3. Prereq: 9 credits in literature. Introduction to the major approaches to literature.

530. Research and Bibliography. (3-0) Cr. 3. F., Alt. SS. Prereq: 12 credits in English. Required of candidates for the M.A. degree in English.


534. Science and Literary Imagination. (3-0) Cr. 3 each time taken, maximum of 6. Prereq: 6 credits in literature. Literature and science considered as complementary expressions of basic cultural paradigms. Close attention to imagery, metaphor, and theories of literary language. Alternate offerings emphasize Newtonian (17th-19th centuries) and modern (19th-20th centuries) periods.

542. 543. 547. Twentieth Century Literature. (3-0) Cr. 3 each time taken, maximum of 6. Prereq: 6 credits in American literature. Selected writers in combination, such as Hawthorne and Poe, Twain and Howells, Melville and James.

545. Significant American Nonfiction. (3-0) Cr. 3 each time taken, maximum of 6. Prereq: 6 credits in American literature. Material studied alternates between transcendentalism as a force in American literature, and trends in American nonfiction since 1840.

546. American Poetry to 1900. (3-0) Cr. 3 each time taken, maximum of 6. Prereq: 6 credits in American literature, including 361. Selected poets in combination.

547. Twentieth Century American Literature. (3-0) Cr. 3 each time taken, maximum of 6. Prereq: 6 credits in American literature, 374 recommended. Studies of non-dramatic literature of the 19th and early 20th centuries, alternating between emphasis on the early Renaissance and on the later Renaissance.

571. Restoration and 18th Century British Literature. (3-0) Cr. 3. Prereq: 6 credits in English literature, preferably 374, 375. Selected poetry and prose.

572. British Drama to 1714. (3-0) Cr. 3 each time taken, maximum 6. Prereq: 6 credits in literature, preferably 373, 374. Studies of selected non-Shakespearean dramatists, alternating between emphasis on the earlier and on the later parts of the period.

574. Chaucer. (3-0) Cr. 3. Prereq: 6 credits, 373 recommended. Intensive study of selected Canterbury Tales and minor poets. Introduction to Chaucer scholarship.

575. Milton. (3-0) Cr. 3. Prereq: 6 credits, 374 recommended. Paradise Lost, with other selections from the poetry and prose. Introduction to Milton scholarship.

576. Nineteenth Century British Literature. (3-0) Cr. 3 each time taken, maximum of 6. Prereq: 6 credits in English literature, 376 or 377 recommended. Studies of selected poets and prose writers of the 19th century, usually alternating between emphasis on the Romantic period and emphasis on the Victorian period.

580. Shakespeare. (3-0) Cr. 3. Prereq: 6 credits in English literature prior to 1800. Shakespeare as poet and dramatist. Chief critical schools and areas of scholarship.

582. (391 DL) The English novel to 1832. (3-0) Cr. 3. Prereq: 6 credits in English literature. Graduate study in conjunction with English 391. Additional readings, project, and special examination for students who enroll for 582. May not be taken by students who have previously earned credit in English 391.

583. (392 DL) The Victorian Novel. (3-0) Cr. 3. Prereq: 6 credits in English literature. Graduate study in conjunction with English 392. Additional readings, project, and special examination for students who enroll for 583. May not be taken by students who have previously earned credit in English 392.

589. Seminar. Cr. var. Prereq: 12 credits in literature, linguistics, or rhetoric (excluding 104-105).

590. Special Topics. Cr. var. Prereq: Permission of the departmental executive officer, according to guidelines available in the department office.

699. Research.
Entomology

Paul A. Dahm, Chair of Department

The Graduate Faculty

Members: Brindle, Coats, Dahm, Guthrie, Hart, Jarvis, Krafur, L. C. Lewis, R. E. Lewis, Mertins, Mullin, Pedigo, Rowley, Showers

Associate Members: DeWitt, Stockdale, Tolleson

The department offers work for the degrees of Master of Science and Doctor of Philosophy with major in entomology. Within the major, the student may specialize in behavior, biological control, ecology, economic entomology, host plant resistance, medical entomology, morphology, pathology, pest management, physiology, systematics, or insecticide toxicity.

Prerequisite to major and minor graduate work in the department is 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.

Any student receiving a graduate degree in entomology shall have one course in at least three of the following areas for the M.S. degree and one course in each of the following areas for the Ph.D. degree: insect morphology, systematic entomology, insect physiology, and insect ecology. Equivalents of these courses taken at other universities will be acceptable.

The Federal Corn Insects Research Unit at Ankeny is available for advanced study in certain phases of entomological research. The department participates in the interdepartmental programs of Immunobiology and Molecular Cellular and Developmental Biology (see Index).

Courses for Graduate Students, major only


Courses Primarily for Graduate Students, major or minor, open to qualified undergraduates

500. Seminar. Cr. 1. F. S. Prereq: Permission of instructor. Reports of research and current literature.


574. Medical Entomology. (2-6) Cr. 4. F. Prereq: 9 credits in biological sciences, Rowley. Identification, biology, and significance of insects and other arthropods that attack people and animals, particularly those that are vectors of disease. Field trips.

575. Biological Control. (3-0) or (3-3) Cr. 3 or 4. Alt. F. offered 1981. Prereq: 370. permission of instructor. Mertins. Theory and practice of biological control of insects and other pests; biology and behavior of entomophagous insects, entomogenous nematodes, and pathogenic microorganisms. Review and critique of important world projects.


590. Special Topics. Cr. 1 to 3 each time taken. Prereq: 15 credits in zoological sciences, permission of instructor. E. Special research topics. T. Internship experience in the techniques of organizing and disseminating applied entomological information. U. Teaching experience.

Courses for Graduate Students, major or minor


999. Research.

Family Environment

Edward A. Powers, Chair of Department

The Graduate Faculty

Members: Bivens, Deacon, Liston (Emeritus), Morris, Peet, Powers, Winter

Associate Members: Budofson (Emeritus), Cole, Heitsley, Jereis, Mercier, Norom, Pickett, Schwieder, Weltha

The department offers the degree of Master of Science with a major in family environment, and the Ph.D. degree as a joint major with another field such as chemistry, child development, economics, education, food and nutrition, home economics education, physics, sociology, and anthropology. A family environment minor is available for Ph.D. students majoring in other departments.

The department cooperates in the interdepartmental programs of Housing, Gerontology, Technology and Social Change, and Water Resources (see Index).

Prerequisite to major work in family environment is the completion of at least 10 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. Educational background in the physical and/or social sciences may be suitable, depending on the student's objectives.

Guidelines for graduate programs of study in family environment have been developed. However, the student's program of study committee has the major responsibility for determining requirements for an individual program.

Courses for Graduate Students, minor only

408. Care of Modern Fabrics. (3-0) Cr. 3. S. Prereq: 3 credits in textiles or household equipment. Application of basic physical and chemical principles to effective clothing care. Analysis of appliance design, materials, and procedures for fabric care. Emphasis on resource conservation. Review of research and current literature.


412. Kitchen, Bath, and Utility Area Planning. (2-2) Cr. 3. S. Prereq: 6 credits in housing, art, and design, or architecture. Criteria for planning of kitchen, bath, utility areas. Application of human engineering principles for effective functioning in work areas. Emphasis on economy, resource conservation, and space adaptation.

415. Families as Consumers. (3-0) Cr. 3. S. F. Prereq: 3 credits in psychology, 3 credits in sociology, Econ 201. Theories of consumer behavior; the family's relationship to the consumer movement; consumer issues, dimensions of consumer role, interaction of consumers; government and the market; consumer decision making; evaluation of information and protection.

446. Housing Alternatives for Individuals and Families. (2-4) Cr. 3. F. Prereq: 249. Meeting human needs at various stages of the life cycle through alternative housing forms. Emphasis on internal housing environment as influenced by social, technological, and physical factors. Field trip. Fee.


479. Family Interaction Dynamics. (3-0) Cr. 3. F. Prereq: 370, 378. Analysis of family interaction processes and patterns with emphasis on relationship dynamics.
Courses Primarily for Graduate Students, major or minor, open to qualified undergraduates.

500. Short Course. Cr. arr. Designed primarily for special groups. Not accepted for graduate credit in family environment.
A. Family Relations and Management
B. Housing
C. Consumer Economics and Management
D. Household Equipment
E. General Family Environment

501. Graduate Study Orientation. (1-0) Cr. 1. F.
Orientation to graduate study and current research in the department.

504. Research Methods and Techniques. (3-0) Cr. 3. S. Prereq: 9 credits in social and/or behavioral sciences. Research methods and techniques applicable to studies of families and households. Emphasis on the solution of practical problems of analyses using SPSS, WYLBUR, and other programs.


521. Housing and the Social Environment. (3-0) Cr. 3. F. Prereq: 504 and courses in behavioral sciences. Housing adjustment behavior of individuals and families in the context of the social and cultural framework of society. Impact of housing on the family.

522. Time and Human Resources. (3-0) Cr. 3. Alt. S., offered 1982. Prereq: 504. Conditions, programs, and policies related to development and allocation of human resources and time, with special reference to impact on families and households.

523. Management within the Family. (3-0) Cr. 3. F. Prereq: 378, 6 credits in sociology or economics. Theoretical developments and research related to the use of family resources to achieve family goals. Emphasis on systems theory as applied to family management.


565. Pragmatics of Family Communication. (3-0) Cr. 3. F. Prereq: 6 credits in behavioral sciences. Influence of communication including language and cultural aspects in family procedures. Emphasis on functional interpersonal communication in maintenance of holistic health of family members.

570. The Individual and Family Development. (3-0) Cr. 3. S. Prereq: 9 credits in behavioral sciences. Experiential learning and encounter with contemporary theories of human potential in individual and family living.


578. Family Theory. (3-0) Cr. 3. S. Prereq: 12 credits in behavioral sciences. Analysis of conceptual frameworks in the area of the family by examining their development, concepts, assumptions, inadequacies, and contradictions.

579. Family Dynamics. (3-0) Cr. 3. F. Prereq: 479 or Soc 485. A psychosocial analysis of intrafamilial interaction processes and patterns with an emphasis upon relationships established as a result of need and power.

580. The Family and the Law. (3-0) Cr. SS. Prereq: 415 or 488 or Mygmt 315. Examination of the effects of selected legislation and cases on individuals and families. Discussion of the legal processes involved in the activities of individuals and families. Implications for effective functioning within the limits of the legal environment. Investigation of legal and quasi-legal services available in a community.


590. Special Topics. Cr. arr. Prereq: 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. Prereq: 10 graduate credits 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
E. General Family Environment

Courses for Graduate Students, major or minor

604. Seminar. Cr. 1 to 3. F.S.
A. Family Relations and Human Development
B. Housing
C. Consumer Economics and Management
D. Household Equipment
E. General Family Environment

669. Research. Cr. arr.
A. Family Relations and Human Development
B. Housing
C. Consumer Economics and Management
D. Household Equipment
E. General Family Environment

Fisheries and Wildlife Biology

For description of courses, see Animal Ecology.

Food and Nutrition

Courses Primarily for Graduate Students, major or minor, open to qualified undergraduates.

500. Short Course. Cr. arr. SS. Prereq: Permission of instructor.

510. Malnutrition in Developing Countries. (2-0) Cr. 2. Alt. S., offered 1983. Prereq: 305 or Alt S.316. Identification and quantifiable assessment of malnutrition in developing countries; social, political, economic, and geographic ecology of malnutrition and its impact on health; protein-calorie malnutrition; vitamin and mineral deficiencies; intervention organizations, programs, and efforts.

520. Current Topics in Food Science. (2-0) Cr. 2. S. Prereq: 427; B 424. Research literature in selected areas of food science.

550. Processed Foods. (3-0) Cr. 3. S. Prereq: 214, 305. Survey of the effects of home and commercial food preparation and processing on the nutrients in food.
Courses for Graduate Students, major or minor

601. Advanced Nutrition. (4-0) Cr. 4. S. Prereq: 305; B B 404 and credit or classification in B B 405. Principles of human nutrition. Nurtition for energy, body structure and function; nutritional interrelationships, nutrient requirements, status assessment, and availability; nutritional diseases, socio-cultural influences on nutrition.

606. Chemical Methods for Research in Food and Nutrition. (1-6) Cr. 3. F. Prereq: 305, Chem 211 or equivalent. Application of chemical techniques to research in nutrition and food science.

607. Animal Experimentation in Nutrition Research. (1-0) Cr. 6. Prereq: 305. The animal feeding experiment as a technique in nutrition research. Principles and basic experimental designs using small laboratory animals. Individual problems in the laboratory animal.

609. Seminar. (1-0) Cr. 1. F. S. Required of all graduate majors in the Food and Nutrition Department.


614. Carbohydrates in Foods. (F. Tch 614) (3-0) Cr. 3. Alt. S., offered 1983. Prereq: 421 or F. Tch 411 or B B 404. Study of production of carbohydrates used in foods, changes they undergo during processing and storage of food, and relation of their functions to their chemical and physical properties.

615. Selected Topics in Nutrition. (2-0) Cr. 2 each time selected. F. Prereq: 601. Series of one-term courses on such topics as protein, vitamins, minerals, lipids, energy metabolism, evaluation of nutritional status. Classical and current research literature in each area.

619. Research Methods in Food Science. (1-6) Cr. 3. F. Prereq: 421; Chem 332; Micro 420. Application of physical, chemical, and organoleptic techniques to research in food science. Use of experimental design, analysis of data, and review of literature.

630. Nutritional Pharmacology and Toxicology. (3-0) Cr. 3. F. Prereq: 601. Mechanistic and biometric concepts, nutrient toxicities and imbalances; diet-drug incompatibilities; nutritional effects on drug metabolism and cancer etiology; toxicants in the food chain; regulatory policy and philosophy.


699. Research.

A. Nutrition

B. Food Science

Food Technology

W. W. Marion, Head of Department

The Graduate Faculty

Members: Glatz, Hammond, Hartman, Kline, Kraft, Marion, Nielsen, Parrish, Robson, Strome r, Walker

Associate Members: Love, Murphy, Olson, Rust, Sebranek, Wilson

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 co-major in animal science and food technology.

The department also participates in the interdepartmental programs of Molecular, Cellular, and Developmental Biology, and Water Resources. (See Index.)

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 any current curriculum in a related science such as dairy technology, bacteriology, chemistry, biochemistry, or engineering.

Preparation in biology, chemistry, physics, and calculus along with knowledge of food processing, sanitation, and preservation are particularly desirable for those intending to pursue graduate work.

Courses for Graduate Students, minor only


302. Processing of Fruits and Vegetables. (2-3) Cr. 3. S. Prereq: 101 or Hort 371. Harvesting, handling, processing, and storage of fruits and vegetables. Current practices and current research in food processing, sanitation, and preservation are particularly desirable for those intending to pursue graduate work.


402. Food Processing Laboratory. (Micro 402) (0-6) Cr. 2. F. Prereq: 102, Micro 300. Thermal processing, low temperature preservation, packaging methods, food fermentations, use of starter cultures. Fee for field trips.

405. Quality Assurance. (2-0) Cr. 2. S. Prereq: 410; Stat 104. Use of biological, chemical and physical analyses to maintain quality and safety. Design of food quality control programs and their application to food systems.

410. Food Analysis. (1-6) Cr. 3. S. Prereq: Chem 211; 231 or 331. Proximate, spectrophotometric, and chromatographic methods for food analysis. Physical properties.

411. Food Chemistry. (2-3) Cr. 3. S. Prereq: B B 301. The structure, properties and reactions of food constituents and commodities.

421. Food Microbiology Laboratory. (Micro 421) (1-6) Cr. 3. S. Prereq: Micro 300. Standard microbiological techniques employed in the food industry, including microscopic examination of foods, sampling methods, plate counts, and other enumeration methods, indicator organisms, food quality and safety. Fee for field trips.

425. Food and Water Sanitation. (Micro 425) (3-0) Cr. 3. S. Prereq: Micro 300. Control methods and regulations for maintaining sanitation and quality of foods and water.

493. Engineering Principles for Food Technology I. (Ag M 493) (2-3) Cr. 3. S. Prereq: Math 160; Phys 106 or 111 or 221. Introduction to the principles of food process engineering. Applications of basic mechanics, electricity, fluid mechanics and heat transfer to food processing. Fee for field trips.


*For graduate majors where undergraduate preparation was not in food technology or food-product technology but in a related science, 8 hours of food technology courses with approval, with approval of the student's program of study committee.

Courses primarily for graduate students, major or minor, open to qualified undergraduates.


Courses for Graduate Students, major or minor


614. Carbohydrates in Foods. (F N 614) (3-0). Cr. 3. Alt. S., offered 1983. Prereq: 411 or B B 404 or F N 421. Study of production of carbohydrates used in foods, changes they undergo during processing and storage of food, and relation of their function to their chemical and physical properties.

626. Advanced Food Microbiology. (Micro 626) (1-0 to 3-0) Cr. 1-3 Alt. S., offered 1982. Prereq: Micro 420. Topics of current interest in food microbiology, including new food-borne pathogens, rapid identification methods, effectiveness of control measures and preservation techniques on microbial growth.

660. Seminar. (1-0) Cr. 1. S.S.S.

690. Special Problems. (2-0.) Cr. 1-5. S.S.S. Prereq: A major or minor in food technology.

699. Research.

Foreign Languages and Literatures

Orrin Finik, Chair of Department

The Graduate Faculty

Members: Bruner, Courteau, Dow, Finik, McVicker, Morris, Thogmartin

Associate Professors: Bernard, Graupera, Judith Lacasa, Nabrotzky, Ruebel, Valdés, von Wittich

Courses for Graduate Students, minor only

French (Frnch)

401. 402. Advanced Composition and Conversation. (3-0) Cr. 3. F, S. Prereq: 401 or 302. Intensive practice in composition and conversation. Development of an appreciation for style, idiomatic usage, and effective expression of ideas. Increased emphasis on vocabulary, building grammatical correctness and compatibility of style and content.

441. Literature of the Renaissance. (3-0) Cr. 3. Alt. F., offered 1981. Prereq: 242 and 301 or 302. Major writers of sixteenth century prose and poetry, including Rabelais, Montaigne, Marguerite de Navarre, the Pèlèade, the Ecole de Lyri. Literary movements in the context of the two major historical phenomena of the century, Humanism and the Reformation.

443. Classical and Baroque Literature. (3-0) Cr. 3. Alt. F., offered 1982. Prereq: 242 and 301 or 302. Study of works of representative authors mostly from the seventeenth century. Included are La Peinture by Corneille, Molière and Racine, poetry and novels of Théophile, Saint-Siméon, La Fontaine, Bécuille, and other prose works of Cyrano de Bergerac.

444. Literature of the Modern Period. (3-0) Cr. 3. Alt. S., offered 1983. Prereq: 242 and 301 or 302. Representative authors of the twentieth century. Proust, Gide, Claudel, Claudoux, Sartre, Camus, Malraux, Mauriac. New-Genius, the little Novelist, and more recent developments. May also include predecessors from the late nineteenth century.

440. Seminar in French Literature. (3-0) Cr. Prereq: 242 and 301 or 302. One 400 level literature course. Study of a selected topic in literature or literary criticism.

440. Independent Study. Cr. 1-6 each time taken. Prereq: Permission of department head. Designed to meet the needs of students who seek work in areas other than those in which courses are offered or who desire to integrate a study of literature or language with special problems in major fields.

German (Ger)

401, 402. Advanced Composition and Conversation. (3-0) Cr. 3 each. 401: F. 402: S. Prereq: 401; 302; 401-402. Study of syntax, modes of expression, intensive practice of composition and conversation based on selected readings.

400. Topics in German Literature. (3-0) Credit 3 F. Prereq: 302 or 322. Study of periods, genres, or individual authors. May be repeated for different offerings to a maximum of 6 credits.

411. Enlightenment — Storm and Stress (3-0) Cr. 3. Alt. F. offered 1982. Prereq: 302 or 322. Readings in German literature of the Enlightenment and Storm and Stress periods.


430. Nineteenth-Century German Literature. (3-0) Cr. 3. Alt. F. offered 1981. Prereq: 302 or 322. Readings in German literature from 1830 to 1914.

444. Twentieth-Century German Literature. (3-0) Cr. 3. Alt. S. offered 1982. Prereq: 302 or 322. Readings in German literature from 1914 to the present.

490. Independent Study. Cr. 1-6 each time taken. Prereq: Permission of department head. Designed to meet the needs of students who seek work in areas other than those in which courses are offered, or who desire to integrate a study of literature or language with special problems in major fields.

Russian (Rus)

401, 402. Advanced Composition and Conversation. (3-0) Cr. 3 each. 401: F. 402: S. Prereq: 401; 302; 401-402. Writing, speaking, analysis of grammar.

442. Literary Masterpieces of the Nineteenth and Twentieth Centuries. (3-0) Cr. 3 each. Alt. Yr., offered 1981-82. Prereq: 301 or 302. Readings, discussions, and compositions based on the works of Pushkin, Lermontov, Gogol, Tolstoy, Dostoevsky, Chekhov, Gorky, Pasternak, Solzhenitsyn.

490. Independent Study. Cr. 1-6 each time taken. Prereq: Permission of department head. Designed to meet the needs of students who seek work in areas other than those in which courses are offered, or who desire to integrate a study of literature or language with special problems in major fields.

Spanish (Span)

401, 402. Advanced Composition and Conversation. (3-0) Cr. 3 each. 401: F. 402: S. Prereq: 401; 302; 401-402. Intensive practice in composition and conversation. Development of idiomatic usage and effective expression of ideas. Increased emphasis on vocabulary building, grammatical correctness, and compatibility of style and content.

Courses Primarily for Graduate Students, major or minor, open to qualified undergraduates

500. Seminar. (1-0) Cr. 1 each time taken. S. Prereq: Permission of instructor. Reports of research and current literature.
504. Advanced Forest Biology and Silviculture. (4-0) Cr. 4. Alt. F. Prereq: 380, 399. Detailed analysis of factors and processes underlying forest and stand growth and development. Applications of this knowledge to forest culture. Experimentation in forest biology.
590. Special Topics. Cr. 2 to 4 each time elected. Prereq: 15 credits of acceptable graduate work, permission of the instructor. A. Forest Biology B. Forest Biometry C. Forest and Recreation Economics D. Forest Management E. Wood Science F. Range Management G. Forest Photographometry I. Forest Recreation Resource Management
594. Advanced Forest Resource Management. (3-0) Cr. 3. F. Prereq: 454. A seminar approach to the critical analysis of forest management problems as exemplified in public agencies and private firms.
599. Research. Cr. 1 to 8. A. Forest Biology B. Forest Biometry C. Forest and Recreation Economics D. Forest Management and Administration E. Wood Science

Courses for Graduate Students, major or minor

601. Research Methods. (3-0) Cr. 3. F. Prereq: Permission of instructor. Forestry graduate student orientation: departmental research philosophy and program; student and faculty research presentations. Scientific method; hypothesis formulation and testing; project and study planning; preparation and critical analysis of study plans. Communication of research results. Institutional factors in research.
602. Forest Biology Seminar. (1-0) Cr. 1. F. Prereq: Permission of instructor. Presentation of papers and discussions of topics on selected areas in advanced forest biology. May be taken up to three times for credit.

General Graduate Studies

(Interdepartmental Program)

Martin Ulmer, Chair. Supervisory Committee

Supervisory Committee: J. W. Eirolf (Arts and Humanities), P. A. Hartman (Biological Sciences), E. C. Jones (International Development Studies), F. C. Peterson (Physical Sciences), M. G. Miller (Social Sciences), L. W. Glass (General)

The degree Master of Science or Master of Arts with major in general graduate studies is available to graduate students who wish to have a more diversified program of advanced study than that generally permitted students who specialize in a single subject. The General Graduate Studies program is considered a terminal master's degree; those wishing to pursue the doctorate should enter departmental programs. Those who elect general graduate studies are allowed to take courses in three different approved graduate areas; each subject contributing a minimum of 10 credits toward the 35 graduate credits required for the degree. Each of the three areas chosen must be specifically authorized for major or minor graduate study in the department statement. Courses which may be used for credit toward this degree are selected from those listed in the Graduate College catalog for graduate credit.

Both thesis and nonthesis options are available. If a thesis is chosen, a maximum of 5 credits in Research 699 may be counted in the total of 35 required credits. If the nonthesis option is elected, evidence of original creative effort must be presented. This may be in the form of a demonstration of independent creative activity such as a written report of a laboratory, field, or library research, a project in fine arts, or some other original contribution acceptable to the student's supervisory committee. In the nonthesis option a maximum of 5 credits in 500-level special topics may be counted toward the total of 35 graduate credits. A graduate advisory committee, in consultation with the student, will decide on the choice of option. The committee also aids the student in planning a program of study and in selecting appropriate courses.

Foreign language requirements, if any, will be decided by the student's committee. Although the program is open to any qualified graduate student, it is most useful to those who wish to improve their subject matter competence for teaching, either in high school, college, or university. Programs in biology, physical sciences, social sciences, humanities, art, or other disciplines can be especially designed for students or teachers who wish to increase their knowledge in several specialized areas. Students who wish to participate in general graduate studies should communicate with the chairman in charge of the program, or with the chairman of one of the subcommittees.

Genetics

Alan G. Atherly, Chair of Department

The Graduate Faculty

Members: Atherly, Imsande, McDonald, Miller, Palmer, Peterson, Pollak, Robertson, Sadanaga, Stadler, Welshons

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.

Prerequisite to major work is the completion of a thorough undergraduate curriculum in a biological science, or in 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, soybean, population, statistical, immunological, microbial, biochemical, developmental, and mammalian cell genetics. Minor work may be taken in agronomy, animal science, bacteriology, botany, horticulture, mathematics, statistics, veterinary medicine, and zoology.

The department also participates in the interdepartmental programs of Molecular, Cellular, and Development Biology, and Immunobiology (See Index.)

Courses for Graduate Students, minor only


Courses Primarily for Graduate Students, major or minor, open to qualified undergraduates

501. Hereditary Mechanisms. (2-0) Cr. 2. F. Prereq: Undergraduate course in biology and genetics. Topics: Recombinational analysis in procaroytes and eukaryotes, variation in chromosomes structure, aneuploidy and euploidy in plants and animals, gene structure and function, and mechanisms of sex determination. Designed primarily for graduate students in an agricultural discipline.


535. Laboratory in Cytogenetics. (0-6) Cr. 2. Alt. S. Prereq: 501 and Bot 444. Palmer. Laboratory methods and techniques for cytogenetical research, with emphasis on plants.


560. Evolutionary Genetics. (2-0) Cr. 2. Alt. F. Prereq: 530 or 320. McDonald. Genetic basis of evolutionary process in higher organisms with emphasis on molecular evolution. Topics covered include: alternative strategies of molecular adaptation, origin and evolution of the genome, regulatory vs. structural gene evolution, gene duplication and rearrangement in evolution.

590. Special Topics. (0 to 3) Cr. Arr. Prereq: 330 or 320.

599. Research.

Courses for Graduate Students, major or minor

610. Genetics of Bacteria and Bacteria Vacteriophage. (Bact. 610) See Microbiology.

615. Molecular Immunology. (B B 615) See Biochemistry and Biophysics.
A declared graduate minor in gerontology consists of a minimum of 12 credits taken from a list of acceptable courses, and from at least two departments. Nine of these 12 credits will be in courses focused specifically on aging. At least one member of the gerontology forum will be on a student's advisory committee; this person must be at least an associate member of the Graduate Faculty for a master's committee and a full member for a doctoral committee. Because gerontology is a rapidly developing area, departments participating in the minor and specific course offerings may change in the future. Contact the chair of the supervisory committee for information on the program and for the list of courses in the graduate minor in gerontology.

History

Richard Lowitt, Chair of Department

The Graduate Faculty

Members: Apt, Cravens, Dobson, Keller, Kottman, Lowitt, McAuliffe, MclJemsey, Plakans, Scholfield, Willett, Wilt

Associate Members: Avraamides, Bennett, McCarthy, Madison, Osborn, Rawson, Whitaker, Wilt

The department offers work for the Master of Arts degree with major in history, for the Master of Arts and Doctor of Philosophy degrees with major in history of technology and science, and minor work for students majoring in other departments. For admission and degree requirements for work in history of technology and science, see separate department brochure.

For the M.A. in history, students may elect a thesis or a nonthesis program. The foreign language requirement or an alternate requirement, such as computer science or statistics, is determined by the student's advisory committee.

The Master of Arts in history program serves as a basis for continued study in history, law, or business; preparation for teaching in high school or junior college, preparation for government service, or as part of a general education.

The department participates in the interdepartmental program of Technology and Social Change. (See Index.)

A history graduate student may take any 400-level course for major graduate credit; however, no more than 12 credits of 400-level courses may be used toward the minimum credits required for the degree as listed on the program of study. Additional work is required for graduate credit.

Courses for Graduate Students

History of Europe (Hist)

401. Ancient Near East (3-0) Cr. 3. F. Avraamides

Political, socio-economic, artistic, and religious history of ancient Mesopotamia and Egypt.

402, 403. Ancient Greece and Rome (3-0) Cr. 3 each. F.S. Avraamides. Ancient Greece from the Bronze Age to the Hellenistic Kingdoms; the evolution of the Greek polis and its cultural contributions. 403. Ancient Rome from the founding of the city of Rome to the rise and decline of the Roman Empire; its political and administrative institutions and cultural contributions.

405, 406. History of Medieval Western Europe (3-0) Cr. 3 each. F.S. Madison. Development of political, economic, and social institutions. 405. Period to 1450. Central Middle Ages, 284-1050. 406. High and Late Middle Ages, 1050-1500.

407. Medieval and Renaissance Italy (3-0) Cr. 3 F. Madison. Development of the city-republics, rise of the universities, new intellectual directions, and historiography.

408. Europe, 1500-1648 (3-0) Cr. 3. Alt. S. Zaring. The Northern Renaissance: the church and Luther; Protestant reform and Roman-Catholic counter-reform; social, cultural, and economic changes; Spain in triumph and decline; religious wars and the emergence of France.

410. 19th Century Europe (3-0) Cr. 3. S. Apt. Europe in the age of nationalism, revolution, and imperialism.

411, 412. Contemporary Europe (3-0) Cr. 3 each. F.S. Will. 411. Europe from the 1850s to the 1930s. 412. Europe since the 1930s with emphasis on the origins, causes, and effects of World War II.


416. European Society in the Age of Enlightenment (3-0) Cr. 3 Alt. F. offered 1982. Plakans. Europe from the mid-seventeenth century to the French Revolution, with emphasis on social structure and on the culture of the traditional social order.

417. European Society and the Industrial Revolution (3-0) Cr. 3. Alt. S. offered 1983. Plakans. England and the continent during the period of European industrialization (1750-1900), with emphasis on the relationship between industrial and social change.

419. French History (3-0) Cr. 3 Alt. F. Modern French history, 1600 to the present.

421, 422. History of Russia (3-0) Cr. 3 each. Yr. Rawson. 421: Russia to 1825. Origins of the Russian people; Byzantine influences; Mongol invasion; rise of Moscow; advent of Westernization. 422: Russia since 1825. The role of autocracy: era of reforms; conflict between state and society; revolution; transformation of society in the Soviet period; the USSR as a world power.


426. Modern East Central Europe (3-0) Cr. 3 Alt. S. offered 1982. Plakans. Political, social, and cultural developments in Czechoslovakia, Poland, the Baltic States, Hungary and the Balkans during the nineteenth and twentieth centuries. Rise of nationalism; creation of independent states; agrarian reform; emergence of communist governments.


430, 431. Modern England (3-0) Cr. 3 each. F.S. Zaring. England from 1608 to 1830. Political, social, cultural, economic development. England as a great power. 431: England since 1830. Parliamentary and constitutional development; social reform and economic change; imperial Britain, the welfare state.

History of Asia, Africa, Latin America (Hist)

436. Modern Japanese History (3-0) Cr. 3 Alt. F. Bennett. Japan 1600 to the present, emphasis on the transformation of feudal Japan into a post-industrial society.

441. History of Mexico (3-0) Cr. 3 S. Osborn. Colonial background and the history of Mexico since independence with emphasis on the significance of the Mexican Revolution for the development of contemporary Mexico.

History of the United States (Hist)

450. Colonial America (3-0) Cr. 3. F. Keller. Exploration, colonization, and development of political, economic,
social and cultural institutions of the North American colonies before 1754.

451. American Revolution, (3-0) Cr. 3. S. Keller. Participates, ideas, and events leading to independence and the foundation of the American Republic, 1754 to 1787.

452. The New Nation, (3-0) Cr. 3. Alt. F. Development of the political institutions and the social, economic, and cultural fabric of the nation from 1787 to 1828.

454. Politics and Sectional Conflict, (3-0) Cr. 3. F. McImsay. Origins of second party system. Social and economic forces that sustained the system and ultimately caused its collapse and sectional division, 1815-1861.

455. The Civil War and Reconstruction, (3-0) Cr. 3. S. McImsay. Emphasis on military and political events of the Civil War and their influence on postwar America, 1861-1877.

457. The Populist-Progressive Years, (3-0) Cr. 3. S. Dobson. The United States’ transition from an agrarian society to a mature industrial giant, emphasizing political, economic, and social developments of the late 19th and early 20th centuries.


462, 463. American Thought and Culture Since 1867. Cr. 3 each. Alt. F. S. Craven. 462. F: 463. S. American cultural values and social and political thought from the seventeenth century to the present. 462. The rise of the middle-class republic, 1667-1866; the role of religion, rationalism, and republicanism in the seventeenth and eighteenth centuries. Enlightenment and Revolution; the Revolution’s legacy, the democratic mode in politics, religion, the economy, society, and culture; impact of Civil War and industrialization. 463. American democracy in the Machine Age, 1865 to the present; multimediawave into social thought, moral values, and culture in the urban-industrial era, 1920-1945 as a turning point; the contemporary situation.

464. Nineteenth Century American Social History. Cr. 3. Alt. S. Schwieder. Rise of modern industrial society in nineteenth century America, the family, churches, and other social institutions, immigration, social and geographical mobility, social, economic, and ethnic stratification.

465. The Westward Movement and Frontier Development. Cr. 3. W. Whitaker. Occupation, distribution, and political organization of the public domain; Indian-white relations; economic exploitation of the public domain (trapping, mining, lumbering, ranching, farming); social and economic adjustments (law and order, religion, education, and culture).

467, 468. History of United States Foreign Policy, (3-0) Cr. 3 each. F. Dobson, Kottman. Diplomatic history emphasizing American influence around the world and the resulting consequences and conflicts. 467. Diplomacy from the American Revolution; America’s rise as a world power; the First World War and thereafter. 468. Diplomacy from the 1930s to the present including U.S.-Soviet Relations, the Second World War, and the Cold War.

History of Technology and Science (Hist)

480. History of Agricultural Sciences and Technology. (3-0) Cr. 3. Alt. S. offered 1982. Marcus. Rise of mechanization and scientific agriculture since the industrial revolution, set in the social and cultural context of the western world.

481. History of Chemical Sciences and Their Applications. (3-0) Cr. 3. Alt. F. offered 1981. Craven. Emergence of the human sciences and technologies — medicine, physiology, cytology, public health, and social sciences — in the social and cultural context of the western world. Emphasis on developments from Darwin and Pasteur to the present.


488. History of American Technology. (3-0) Cr. 3. Alt. S. offered 1981. Marcus. Technology in America with emphasis on the industrial revolution and its consequences American invention and its relation to science; technology as social response and perception of it as social problem; locus of support for process of technological innovation.

489. History of American Science. (M.E.489) (3-0) Cr. 3. Alt. S. Offered 1982. Craven. Science and its social relationships since the mid-nineteenth century; interaction of scientific discoveries and the development of society. Continuing impact of Darwinism and other scientific theories; science and social thought; modern medicine and public health; science and industry; science and agriculture; the social sciences; government and science; science and the consumer; the atomic age; big science and the environmental dilemma; the energy crisis; the role of science in a democracy.

Any course may be taken independently.

Courses Primarily for Graduate Students, major or minor, open to qualified undergraduates.

History of Europe (Hist)

512. Proseminar in European History, (3-0) Cr. 3 each time taken. Prereq: Permission of instructor. Readings in European History.

A. Ancient
B. Medieval
C. Modern

594. Seminar in European History, (3-0) Cr. 3 each time taken. Prereq: Permission of instructor. Topics vary each time offered.

A. Ancient
B. Medieval
C. Modern

History of Asia, Latin America (Hist)

510. Proseminar in East Asian History, (3-0) Cr. 3 each time taken. Prereq: Permission of instructor. Readings in East Asian History. Topics vary each time offered.

513. Proseminar in Latin American History, (3-0) Cr. 3 each time taken. Prereq: Permission of instructor. Readings in Latin American history. Topics vary each time offered.

592. Seminar in East Asian History, (3-0) Cr. 3 S. Prereq: Permission of instructor. Topics vary each time offered.

595. Seminar in Latin American History, (3-0) Cr. 3 each time taken. Prereq: Permission of instructor. Topics vary each time offered.

History of the United States (Hist)

511. Proseminar in American History, (3-0) Cr. 3 each time taken. Prereq: Permission of instructor. Readings in American history. Topics vary each time offered.

A. Colonial period
B. Nineteenth century
C. Twentieth century

593. Seminar in American History, (3-0) Cr. 3 each time taken. Prereq: Permission of instructor. Topics vary each time offered.

A. Colonial Period
B. Nineteenth Century
C. Twentieth Century

Topical Courses

514. Proseminar in Comparative Economic History, (3-0) Cr. 3 each time taken. Prereq: Permission of instructor. Readings in comparative economic history. Topics vary each time offered.

580. Museum Internship, Cr. varies each time taken. Prereq: 15 graduate credits in history, permission of instructor.

583. Historical Methods, (3-0) Cr. 3. Prereq: Permission of instructor. Original sources, bibliography, criticism of evidence, form, statistical analysis. A. Written evidence and analysis B. Statistical evidence and demographics

585. Teaching Methods, Cr. 1 to 3 each time taken. Prereq: Permission of instructor. Topics vary each time offered.

A. Teaching Methods
B. Curriculum Development in History
C. Implementing Teaching Techniques

590. Special Topics, Cr. 1 to 3 each time taken. Prereq: Permission of instructor.

597. Seminar in Comparative Economic History, (3-0) Cr. 3 each time taken. Prereq: Permission of instructor. Topics vary each time offered.

598. Introduction to Archives and Special Collections, (3-0) Cr. 2 each time taken. Prereq: Graduate classification.

History of Technology and Science (Hist)

The graduate program in history of technology and science has been restructured with a new sequence of courses leading to the M.A. and Ph.D. degrees.

570, 571. Seminar in General History of Science I, II, (3-0) Cr. 3 each. Yr. Wilson. The history of science from pre-classical civilizations to the Age of Galileo, and from Galileo to modern times, with emphasis on the historical literature, varying interpretations of the period, and problems for continuing research.

574, 575. Seminar in General History of Technology I, II, (3-0) Cr. 3 each. Yr. Marcus. The history of technology from pre-classical civilizations to the eve of the Industrial Revolution, and from the Industrial Revolution to modern times, with emphasis on the historical literature, varying interpretations of the period, and problems for continuing research.

576, 577. Seminar in Historiography of Technology and Science I, II, (3-0) Cr. 3 each. Yr. Schofield. Investigation in the bibliography, philosophy, and professional problems of the history of technology and science. Required of all graduate students in the history of technology and science program.

Courses for Graduate Students, major or minor


699. Research.
Home Economics Education

Ruth P. Hughes, Head of Department

The Graduate Faculty
Members: Beavers, Fanslow, Hughes
Associate Members: Amos, Hausafus, Ralston, Schultz, Williams

The department offers work for the degrees of Master of Science, Master of Education, and Doctor of Philosophy with major in home economics education. Minor is available for students who are majors in other departments.

Students majoring in home economics education should have fundamental knowledge of psychology, education, sociology, and home economics. Each program of study is planned to meet individual needs.

Courses in statistics are included in the program of study for the Master of Science and Doctor of Philosophy degrees with a higher level of competence required for the degree of Doctor of Philosophy.

Courses for Graduate Students, minor only

410. Educational Principles for Home Economists
Offerings: (2-0) Cr. 2. F.S. Prereq: 20 hours in home economics subject matter. Use of principles of learning in developing instructional strategies and evaluation techniques. Program development appropriate for formal and informal offerings in home economics.

413. Educational Strategies for Home Economics Areas
(0-3) Cr. 1. S. Prereq: Classification in 410. Application of methods and techniques for teaching home economics in formal and informal settings. Not open to those with credit in 411, 412. Fee.

Courses Primarily for Graduate Students, major or minor, open to qualified undergraduates.

500. Short Courses
Cr. Arr. SS. Prereq: Permission of instructor.
A. Adult Education
B. Curriculum
C. Evaluation
D. Supervision and Administration
E. General
F. Human Relations
G. Future Homemakers of America
H. Special Needs

507. Curriculum Development in Teaching Vocational Home Economics
(3-0) Cr. 3. F. Alt. SS. offered 1982. Prereq: Teaching experience. Application of new knowledge, career development, and educational theory to curriculum planning in both consumer and homemaking and occupational programs. Coordination and laboratory techniques for occupational programs included.

508. Methods of Teaching Adult Vocational Home Economics
(2-0) Cr. 2. S. First 8 weeks. Prereq: 411. Planning and organizing adult home economics education programs for young, middle-aged, and older adults. Selection, use, and evaluation of teaching techniques suited to group work with adults and to informal education in home economics.

511. Research Design in Home Economics Education

515. Evaluation in Home Economics

520. Supervision in Home Economics
(2-0) Cr. 2. Alt. SS. offered 1983. Principles and functions of supervision emphasizing observation, conferences, and evaluation. Application to student teaching, adult education experiences, state department of education, and other supervisory situations.

590. Special Topics
Cr. Arr. Prereq: 6 credits in education or educational psychology.
A. Adult Education
B. Administration
C. Curriculum
D. Evaluation
E. Extension
F. Supervision
G. General
I. Teacher Education
J. Research Methodology
K. Occupational Education
M. Human Relations
P. Special Needs
R. Vocational Education

Courses for Graduate Students, major or minor

601. Philosophy of Home Economics Education
(1-0) Cr. 1. F. Prereq: HST 420, HPC 581. Integrating philosophies of education and home economics into an operative philosophy.

607. Home Economics Curriculum

608. Adult Education in Home Economics
(2-0) Cr. 2. Alt. SS. offered 1983. Prereq: 508 or experience in adult education. Philosophy of adult education in home economics. Latest research findings in the field of adult and family life education. Emphasis on planning family life courses for informal adult education programs.

610. Seminar
Cr. 1. each semester. F.S. Offered on satisfactory-fail basis only.

611. Research Development in Home Economics Education

615. Program Evaluation in Home Economics

618. Administration of Teacher Education Programs in Home Economics
Cr. 1 to 2. F.S. Prereq: Master's degree in home economics or education. May be taken more than once for credit. Study of current undergraduate programs in home economics education; observation and participation in ongoing undergraduate courses including student teaching experiences. Provides background for those preparing to assume administrative roles in teacher education. Offered on satisfactory-fail basis only.

620. Administration in Home Economics
(2-0) Cr. 2. Alt. S. offered 1983. Prereq: Graduate work in home economics or higher education. Study of home economics in higher education, with emphasis on land grant institutions. Administrative roles and their interrelationships. Discussion of current issues and trends in home economics and higher education.

699. Research.

Home Economics Studies

Julia F. Anderson, Chair of Department

The Graduate Faculty
Members: Anderson, Deacon, Heltsley, Hilton
Assistant Member: Meixner

Courses for Graduate Students, major or minor.
540. Seminar
Cr. 1-3. F.S.

590. Special Topics
Cr. Arr.

Horticulture

Charles V. Hall, Head of Department

The Graduate Faculty
Members: Denisen, Hall, Hodges, Kelley, Mahlstede, Weigle

Associate Members: Bauske, Bhella, Buck, Christians, Domoto, Durso, Gladon, Summers, Taber

The department offers work for the degrees of Master of Science and Doctor of Philosophy with major in horticulture, and minor work for students taking work in other departments. Under special circumstances a nonthesis master's degree is available.

Prerequisite to major graduate work is the completion of courses covering horticulture, botany, and the underlying sciences.

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 Master of Science or the Doctor of Philosophy degree.

The department also cooperates in the interdepartmental program of Water Resources (See Index.)

Courses for Graduate Students, minor only

432. Retail Floriculture
(2-2) Cr. 3. F. Prereq: 231, 332. Permission of the instructor. Florists' qualifications, business aspects, professional organizations in the industry, and merchandising. Laboratories include designing and servicing floral displays and judging floral quality. Extensive reading required. Fee for field trips. Plant materials fee.

433. Tropical and Subtropical Ornamental Plants
(2-2) Cr. 3. S. Prereq: Bot 306. Origin, identification, classification, and description of conservatory plants.

442. Nursery Management
(2-2) Cr. 3. S. Prereq: 221, Agrin 154. Equipment, including land, packing sheds, storage sheds, frames, glasshouses, and irrigation devices; transplanting and management of plants; relation to other fields of horticulture; protection of nursery plants from climatic, disease, and insect difficulties.

461. Small Fruits
(1-2) Cr. 2. S. Prereq: 221. Principles and practices in handling and marketing, and commercial vineyards and plantations of strawberries, bush fruits, and miscellaneous small fruits.

462. Fruit and Nut Culture
(2-2) Cr. 3. S. Prereq: 221. Principles and practices of fruit and nut culture and production. Planting, pruning, propagation, maintenance, pest control, and physiology of growth and development.
Housing

(Interdepartmental Minor)

G. E. Bivens, Chair, Supervisory Committee


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: Art and Design, Architecture, Family Environment, Landscape Architecture or Community 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 cooperating department in which the student majors. The degree will be in the major department with a minor in housing.

Programs in housing should be planned to include courses from several of the following departments:

- Art and Design: 590E, 699
- Architecture: 466, 467, 468, 507, 563, 566, 577, 590
- Construction Engineering: 371, 372
- Economics: 401, 402, 405, 461, 480, 565, 566
- Landscape Architecture: 590, 650, 699
- Political Science: 410, 471, 476, 510, 512, 571, 550G
- Sociology: 410, 411, 415, 464, 550, 555, 575, 576
- Statistics: 401, 402, 421
- Community and Regional Planning: 380*, 383*, 395*, 405*, 492*, 511, 515, 520, 524, 527, 561, 575, 590, 592

*Graduate credit not available to majors in this department.

Facilities and qualified staff exist in such areas as immunogenetics, physiology of antibody formation, cell-mediated immunity, immun chemotherapy, immunocytoLOGY, immunopathology, microbial immunity, immunoparasitology, and serology.

A student majoring in immunobiology will choose a major professor from the graduate faculty membership of cooperating departments and will develop a program of study under the guidance of a committee nominated by the major professor, approved by the chairman of the immunobiology program, and appointed by the dean of the Graduate College.

Students desiring to do graduate work with a major in immunobiology should have a bachelor’s degree in a related science or discipline.

Immunobiology students should include in their program of study a core of courses which will provide a broad coverage of the basic program in immunobiology. Formal courses in immunology, biochemistry, and statistics are recommended. The following listing should be utilized in the selection of core courses for inclusion in the program.

Courses for Graduate Students, major or minor

489. Principles of Immunology. (VMPM 489) See Veterinary Microbiology and Preventive Medicine.

520. Medical Immunology I. (VMPM 520) See Veterinary Microbiology and Preventive Medicine.

520L. Medical Immunology Laboratory. (VMPM 520L) See Veterinary Microbiology and Preventive Medicine.


575. Immunology. (Micro 575) See Microbiology.

590. Special Topics. Cr. 1 to 3 as arranged. Offered on request. Prereq: Permission of instructor. Experimental methods applied in subdisciplines of immunobiology.

- A. Immunobiology
- B. Immunology
- C. Immunogenetics
- D. Immunologic Disease
- E. Immunoparasitology

595. Immunobiology Seminar. (1-0) Cr. 1. S. Prereq: Permission of instructor.

615. Molecular Immunology. (B 615) See Biochemistry and Biophysics.

629. Medical Immunology II. (VMPM 629) See Veterinary Microbiology and Preventive Medicine.


699. Research.

Immunobiology

(Interdepartmental Program)

D. E. Reed, Chair, Supervisory Committee

Supervisory Committee: D. L. Harris, A. Nordskog, C. D. Thoen, W. J. Zimmerman

Work is offered for the degrees Master of Science and Doctor of Philosophy with major in immunobiology under a cooperative arrangement with the departments of Agronomy, Animal Science, Bacteriology, Biochemistry and Biophysics, Food and Nutrition, Genetics, Veterinary Microbiology and Preventive Medicine, Veterinary Pathology, and Zoology.
Industrial Administrative Sciences

(Interdepartmental Program)

David B. Vellenga, Chair, Supervisory Committee

Supervisory Committee: W. O. Meeker, Jr., D. R. Starleaf, V. Tamashunas

Work is offered for the nonthesis degree Master of Science with a major in industrial administrative sciences under an interdepartmental arrangement. Cooperating departments include economics, industrial engineering, statistics and the School of Business Administration. A minor is offered for students majoring in areas other than industrial administrative sciences. The program of formal courses is oriented toward developing administrators or managers for all types of business and governmental organizations. Applicants need not have taken an undergraduate major in business or a related area. However, they are encouraged to obtain background in some of the following: calculus, statistics, accounting, marketing, finance, transportation, economics, industrial engineering, sociology, and psychology.

Students majoring in industrial administrative sciences will choose a major professor from the graduate faculty of industrial administrative sciences. The student's program of study will be developed with the guidance of an advisory committee selected by the student and the major professor, approved by the chairman of the Industrial Administrative Sciences Supervisory Committee, and appointed by the dean of the Graduate College. The program total of 36 semester credits includes work in the areas of human resource management; quantitative methods; economics; the business environment; applications (production, accounting, marketing, transportation and logistics, and finance); business policy; and electives. The program agreed upon by the student and the student's committee shall include a sufficient number of 500 and 600 level courses to be consistent with quality graduate work on the master's level. Although this is a nonthesis degree, a creative component is required of each student. This is accomplished by taking a minimum of three credits in special topics from one of the cooperating departments.

Students majoring in industrial administrative sciences shall have a faculty member representing the interdepartmental program on their committee. At least six courses, one-half of which are on the 500 level, shall be selected from designated course offerings in at least two of the cooperating departments. A minimum of two courses must be included from courses chosen in any of the cooperating departments. A minor cannot include courses that are offered by the department in which the student is a major.

Submission of Graduate Management Admission Test or Graduate Record Examination aptitude test scores is required when seeking admission as a major in the program.

A partial listing of required or recommended courses for a major in industrial administrative sciences is as follows:

- Human resource management — selection to be made from Econ 596; I 424; 425; Psych 450, 451.
- Quantitative methods — selection to be made from I E 511, 518; Stat 402; 432, 539.
- Economics and the business environment — Econ 495, 496, and Mgmt 510 required.
- Applications in business — required courses include Mkt 540, Fin 550, TrLog 560, Acct 560, and one industrial engineering production course, I E 551.
- Business policy — Mgmt 578 required.
- Electives — courses are selected from the cooperative department and numerous complementary areas.

Industrial Education

William D. Wolansky, Head of Department

The Graduate Faculty

Members: Miller, Wolansky

Associate Members: Arcy, Beno, Gelina, McKay, McPherson, Parks, Riley, Sherrick, Van Ast

The department 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 industrial vocational-technical education, industrial education, or occupational and traffic safety education.

Prerequisite to major graduate work is preparation equivalent to the completion of the undergraduate curriculum in industrial education at Iowa State University and adequate proof that the student ranks above average in scholastic ability. The student must also possess adequate promise as a leader within the profession.

Though the department stipulates no foreign language requirement for either the Master of Science or Doctor of Philosophy degree, it is essential in individual cases to specify competence in one or more languages.

Students not electing the thesis option, master's degree level, will be required to complete a minimum of 3 credits of a creative component project.

The department participates in the interdepartmental program in Technology and Social Change. (See Index.)

Course for Graduate Students, minor only

464. Aerospace Workshop for Educators. (2-2) Cr. 3. Aircraft, weather, navigation, and governmental regulations related to the fields of aerospace and aviation.

Courses Primarily for Graduate Students, major or minor, open to qualified undergraduates

Prior to registration for graduate level vocational certification courses, the student shall be classified as a senior or have an earned bachelor's degree, and be required to complete additional assigned readings, term papers, and graduate projects.


529. Human and Public Relations for Industrial and Technical Education. (2-0) Cr. 2. Prereq: IV 514. Identifying a plan of public relations for industrial and technical education; analysis of publics that need to be reached, effect of human relations on public relations; criteria for evaluating public relations.

532. Industrial Arts and Technology for Children. (2-2) Cr. 3. Prereq: 10 credits in elementary education or industrial education. Development of elementary school programs in industrial arts. Identification of psychomotor and developmental factors in children related to tool and material manipulation. Integration of technology concepts into the elementary school curriculum. Use of industrial arts concepts to facilitate concept mastery in other disciplines.

550. Industrial and School Shop Safety. (3-0) Cr. 3. Prereq: 310. Safety as it pertains to the industrial arts and industrial vocational-technical education. OSHA and IOSH regulations and the standards as required by OSHA and IOSH.

554. History and Philosophy of Industrial Education. (3-0) Cr. 3. Prereq: 512. 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. Prereq: IV 517. Administration, supervision, curriculum development, selection of staff, and public relations. Evaluating administrative and supervisory efforts, program modification. Field trips to schools and industries.

557. Organization and Management of the Industrial Education Laboratory. (3-0) Cr. 3. Prereq: 410. Principles and practices involved in the planning, organization, and management of the school shop; responsibilities of the school administrator and teacher; basic principles of planning; selection and purchase of machine tools; equipment and materials; maintenance; storage and control of machine tools; tool and equipment; managing the shop for effective work.


580. Advanced Topics in Graphic Communications. (2-4) Cr. 4. Prereq: 425. Exploration of computer graphics. Advanced design and drawing applications. Integration of aesthetic, historical, technical, and design factors specifications in product design; evaluation of product design. Opportunity for individual creativity and specialization in an area of interest.


580. Special Topics in Industrial Education. Cr. 1-4. Prereq: Graduate classification in industrial education. Special topics in industrial education: administration, curriculum, evaluation, research, history, safety, technical education, etc.

593. Workshop in Industrial Education. Cr. 1 to 3. Prereq: 15 credits in industrial education.

669. Effective Motorcycle. Cr. 1-3. A discipline-related problem to be identified and completed under the direction of the program advisor. Three credits required for all nonthesis master's degree students.

Courses for Graduate Students, major or minor

615. Seminar. Cr. 2-3. Prereq: Credit or classification in 401.

644. Futuristics in Industrial Education. (3-0) Cr. 3. Prereq: Graduate classification, permission of instructor. A critical analysis of industrial education in changing roles and requirements of education. Future alternatives for industrial education with relationship to society, education, and technology.
Safety Education and Driver Education (Saf)

Courses Primarily for Graduate Students, open to qualified undergraduates

500. Administration of Accident Prevention Programs. (3-0) Cr. 3. Prereq: 491. Procedures for organizing and administering an occupational and traffic safety education program.

515. Curriculum Development for Safety Programs. (3-0) Cr. 3. S. Prereq: 315 or 415. Theory and principles of curriculum development, including techniques applicable to traffic and occupational safety.

541. Safety Symposium. (1-0) Cr. 1. F. Prereq: 9 hours in related courses. A broad overview of the entire field of safety through outside readings by the classroom participants.

590. Special Topics in Safety Education. (Arr.) 1-3. Cr. Prereq: 15 credits in occupational and/or traffic safety education.

599. Creative Component. Cr. 3. A discipline-related problem to be identified and completed under the direction of the program advisor. Three credits required for all nonthesis/master’s degree students.

Industrial Engineering

Keith L. McRoberts, Chair of Department

The Graduate Faculty

Members: Adams, Berger, Cowles, David, McRoberts, Maistrom, Montag, Moore, G. W. Smith, Walkup (Emeritus)

Associate Members: Barta, Classen, Even, Lamp, Meeks, C. E. Smith, Tamashunhas, Vaughn

The department offers work leading to the degrees of Master of Engineering and Master of Science with majors in industrial engineering and engineering education. The degree of Doctor of Philosophy with major in engineering education, and minor work to students taking major work in other departments. Graduate work is designed to improve the student’s ability in the professional practice of industrial engineering and to develop research capability.

The prerequisite to major graduate work is the completion of a curriculum substantially equivalent to that required of undergraduate students in engineering at this institution.

With the help of a program of study committee, a graduate student designs an educational program in areas within industrial engineering and engineering education. Typical areas of concentration include engineering economics and capital budgeting; management science; management and regulation of public utilities; systems analysis and control; production systems analysis and design; human resources management; life analysis and depreciation; industrial engineering; operations research and optimization; management information systems design; safety engineering; human factors engineering; and legal aspects of engineering administration. A specialization in operations research leading to a Master of Science degree is co-offered with the Department of Statistics.

The department also particiates in the following interdepartmental programs: Industrial Administrative Sciences, Industrial Relations, Energy Systems Engineering, Technology and Social Change and Transportation Planning. (See Index.)

Courses for Graduate Students, minor only

*304. Analysis for Engineering Economy. (2-0) Cr. 2. F. Prereq: Junior classification and Com S 172 Engineering/managerial analysis of the economic aspects of public and private projects and proposals. Decisions involving the expenditure of capital funds. Alternative sources of funds; time value of money; methods of determining rate of return; indifference curves. 312. Industrial Operations Research. (4-0) Cr. 4. F. Prereq: 209, 250. Math 266, credit or classification in Stat 231. Concepts, analysis techniques, optimization techniques, and applications of operations research to industrial engineering. Construction and optimization of models for industrial systems using linear programming, queueing theory, and simulation. Use of problem-oriented languages such as MPS, GPSS, and FORTRAN in solving problems.

333. Computer Graphics. (2-0) Cr. 2 or 3. S. Prereq: Com S 172 or 112. Techniques for graphical man-machine communications. Use of available facilities. Graph plotting, two-dimensional and three-dimensional applications. Requirements and applications for interactive graphic communications. Individual projects. The optional third credit allows a project.

341. Material and Project Control. (3-0) Cr. 3. F. Prereq: 312 Analysis of inventory systems and sequencing and scheduling problems in the control of material flow and application in industrial systems. Material requirement planning and project control techniques such as PERT and PERT/COST systems are included. Construction of mathematical models, use of heuristic techniques, and use of problem-oriented languages such as FORTRAN in solving problems. Project involving design of material control systems required.

361. Industrial Quality Control and Inspection. (3-0) Cr. 3. F. Prereq: 250. Stat 231. Techniques for obtaining measurements on industrial products and the statistical treatment of data to assure quality. Project involving the design of quality systems.

374. Industrial Methodology. (2-0) Cr. 2. F. Prereq: 250 or 252, 255, M S E 271. Analysis of industrial methods including fabrication, forming, cutting, welding, assembly inspection and finishing methods. Tooling methods including numerical and computer control of machines. Development of the manufacturing process from the economic aspect.

*375. Industrial Organization and Work Analysis. (3-0) Cr. 3. F. Prereq: Junior Classification. Industrial ownership, types of organizations. The principles and methods of production control, inspection, wage systems, cost control, with a special emphasis on work analysis, methods and measurement.

*404. Engineering Economy. (3-0) Cr. 3. F. Prereq: Econ 201, Acc 381. Application of fundamentals of economics to engineering problems. The concepts of financial evaluation, developing, and managing industrial projects.

407. Engineering Valuation. (3-0) Cr. 3. F. Prereq: Econ 201, 2 credits in 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.

421. Safety Engineering. (2-0) Cr. 2. F. Prereq: 250 or 375. Principles of hazard identification and accident prevention in the work environment. Hazards and their control to reduce the risk of accidents/laziness. Incentives to provide a safe working environment including economic and legal aspects.

423. Industrial Compensation. (2-2) Cr. 3. F. Prereq: 250 or 375. Principles of payment plans for work, performance evaluation, and wage survey. Incentive programs and employee benefit packages analyzed.

Courses Primarily for Graduate Students, major or minor, open to qualified undergraduates.

504. Advanced Engineering Economy. (3-0) Cr. 2 or 3.
Prereq: 209, 312 or 511. Prerequisite: two credit hours of microeconomics and macroeconomics. This course covers the basic principles of engineering economy. It includes an introduction to the concept of the time value of money, the economic analysis of alternative courses of action, and the evaluation of investment projects. The course also covers the use of mathematical models in engineering economy.

505. Capital Expenditure Programming. (3-0) Cr. 3.
Prereq: 401, 404. This course covers the principles and techniques of capital investment analysis and decision making. It includes an introduction to the concepts of capital budgeting, including the evaluation of investment alternatives and the selection of the most appropriate investment projects. The course also covers the use of financial models in capital investment analysis.

506. Engineering Aspects of Public Utility Administration. (3-0) Cr. 2.
Prereq: 312 or 407. This course covers the principles and techniques of public utility administration. It includes an introduction to the concepts of utility regulation, including the evaluation of utility rates and the selection of the most appropriate utility rates. The course also covers the use of financial models in utility administration.

507. Depreciation Estimates. (3-0) Cr. 3.
Prereq: 407. This course covers the principles and techniques of depreciation estimation. It includes an introduction to the concepts of asset valuation, including the evaluation of asset life and the selection of the most appropriate asset valuation methods. The course also covers the use of financial models in depreciation estimation.

509. Engineering Valuation Practice. (2-0) Cr. 2.
Prereq: 407. This course covers the principles and techniques of engineering valuation. It includes an introduction to the concepts of asset valuation, including the evaluation of asset life and the selection of the most appropriate asset valuation methods. The course also covers the use of financial models in engineering valuation.

Prereq: Math 267, Stat 231, and 241. This course covers the principles and techniques of operations research. It includes an introduction to the concepts of operations research, including the evaluation of operation systems and the selection of the most appropriate operation systems. The course also covers the use of mathematical models in operations research.

512. Queuing Theory and Applications. (2-0) Cr. 2.
Prereq: 312 or 511. This course covers the principles and techniques of queuing theory. It includes an introduction to the concepts of queuing theory, including the evaluation of queuing systems and the selection of the most appropriate queuing systems. The course also covers the use of mathematical models in queuing theory.

514. Advanced Material Control. (3-0) Cr. 3.
Prereq: 341, 511. This course covers the principles and techniques of material control. It includes an introduction to the concepts of material control, including the evaluation of material control systems and the selection of the most appropriate material control systems. The course also covers the use of mathematical models in material control.

515. Management Science (4-0) Cr. 4.
Prereq: 341 or 511. This course covers the principles and techniques of management science. It includes an introduction to the concepts of management science, including the evaluation of management science systems and the selection of the most appropriate management science systems. The course also covers the use of mathematical models in management science.

517. Design of Industrial Engineering Systems. (2-1) Cr.
Prereq: 312 or 511. This course covers the principles and techniques of system design and system development. It includes an introduction to the concepts of system design and system development, including the evaluation of system design and system development systems and the selection of the most appropriate system design and system development systems. The course also covers the use of mathematical models in system design and system development.

Quantitative and simulation methods are used to analyze and design effective systems for engineering, quality, planning and other types of operations. The course also covers the use of mathematical models in system design and system development.

Courses for Graduate Students, major or minor

608. Depreciation Accountancy. (3-0) Cr. 3. Alt. S. offered 1982. Prereq: 507. This course covers the principles and techniques of depreciation accountancy. It includes an introduction to the concepts of depreciation accountancy, including the evaluation of depreciation accountancy systems and the selection of the most appropriate depreciation accountancy systems. The course also covers the use of mathematical models in depreciation accountancy.

Prereq: 312 or 407. This course covers the principles and techniques of human resource management. It includes an introduction to the concepts of human resource management, including the evaluation of human resource management systems and the selection of the most appropriate human resource management systems. The course also covers the use of mathematical models in human resource management.

527. Dynamics of Industrial Organizations. (2-2) Cr.
Prereq: 312 or 511. This course covers the principles and techniques of industrial organizations. It includes an introduction to the concepts of industrial organizations, including the evaluation of industrial organizations systems and the selection of the most appropriate industrial organizations systems. The course also covers the use of mathematical models in industrial organizations.

531. Sequential Process and Product Control. (Stat 531).
Prereq: 533. This course covers the principles and techniques of sequential process and product control. It includes an introduction to the concepts of sequential process and product control, including the evaluation of sequential process and product control systems and the selection of the most appropriate sequential process and product control systems. The course also covers the use of mathematical models in sequential process and product control.

533. Reliability. (Stat 533).
Prereq: 533. This course covers the principles and techniques of reliability. It includes an introduction to the concepts of reliability, including the evaluation of reliability systems and the selection of the most appropriate reliability systems. The course also covers the use of mathematical models in reliability.

534. Mathematical Programming I. (4-0) Cr.
Prereq: 511, Math 267. This course covers the principles and techniques of mathematical programming I. It includes an introduction to the concepts of mathematical programming I, including the evaluation of mathematical programming I systems and the selection of the most appropriate mathematical programming I systems. The course also covers the use of mathematical models in mathematical programming I.

535. Mathematical Programming II. (4-0) Cr.
Prereq: 534 or Stat 540. This course covers the principles and techniques of mathematical programming II. It includes an introduction to the concepts of mathematical programming II, including the evaluation of mathematical programming II systems and the selection of the most appropriate mathematical programming II systems. The course also covers the use of mathematical models in mathematical programming II.

539. Game Theory. (Econ 539, Stat 538).
Prereq: 533. This course covers the principles and techniques of game theory. It includes an introduction to the concepts of game theory, including the evaluation of game theory systems and the selection of the most appropriate game theory systems. The course also covers the use of mathematical models in game theory.

545. Advanced Facilities Design. (3-0) Cr. Alt. F.
Prereq: 441. This course covers the principles and techniques of advanced facilities design. It includes an introduction to the concepts of advanced facilities design, including the evaluation of advanced facilities design systems and the selection of the most appropriate advanced facilities design systems. The course also covers the use of mathematical models in advanced facilities design.

Prereq: 515. This course covers the principles and techniques of industrial engineering concepts. It includes an introduction to the concepts of industrial engineering concepts, including the evaluation of industrial engineering concepts systems and the selection of the most appropriate industrial engineering concepts systems. The course also covers the use of mathematical models in industrial engineering concepts.

552. Industrial Organization Theory. (2-0) Cr. 2.
Prereq: 404, 511. This course covers the principles and techniques of industrial organization theory. It includes an introduction to the concepts of industrial organization theory, including the evaluation of industrial organization theory systems and the selection of the most appropriate industrial organization theory systems. The course also covers the use of mathematical models in industrial organization theory.

560. Industrial Information Systems. (3-0) Cr.
Prereq: 209. This course covers the principles and techniques of industrial information systems. It includes an introduction to the concepts of industrial information systems, including the evaluation of industrial information systems systems and the selection of the most appropriate industrial information systems systems. The course also covers the use of mathematical models in industrial information systems.

571. Theory and Principles of Work-Time Relationships. (2-0) Cr. 2. Alt. S., offered 1982. This course covers the principles and techniques of work-time relationships. It includes an introduction to the concepts of work-time relationships, including the evaluation of work-time relationships systems and the selection of the most appropriate work-time relationships systems. The course also covers the use of mathematical models in work-time relationships.

577. Human Factors. (2-0) Cr. 3.
Prereq: 274, Stat 231 or 401. This course covers the principles and techniques of human factors. It includes an introduction to the concepts of human factors, including the evaluation of human factors systems and the selection of the most appropriate human factors systems. The course also covers the use of mathematical models in human factors.

581. Administrative and Tax Law Aspects of Engineering. (3-0) Cr.
Prereq: 480. This course covers the principles and techniques of administrative and tax law aspects of engineering. It includes an introduction to the concepts of administrative and tax law aspects of engineering, including the evaluation of administrative and tax law aspects of engineering systems and the selection of the most appropriate administrative and tax law aspects of engineering systems. The course also covers the use of mathematical models in administrative and tax law aspects of engineering.

582. Intellectual Property and Product Liability Aspects of Engineering. (3-0) Cr.
Prereq: 480. This course covers the principles and techniques of intellectual property and product liability aspects of engineering. It includes an introduction to the concepts of intellectual property and product liability aspects of engineering, including the evaluation of intellectual property and product liability aspects of engineering systems and the selection of the most appropriate intellectual property and product liability aspects of engineering systems. The course also covers the use of mathematical models in intellectual property and product liability aspects of engineering.

590. Special Topics. Cr. 1 to 5.
Prereq: 511. This course covers the principles and techniques of special topics. It includes an introduction to the concepts of special topics, including the evaluation of special topics systems and the selection of the most appropriate special topics systems. The course also covers the use of mathematical models in special topics.

Industrial Relations

(Interdepartmental Program)

Paul M. Michusky, Chair, Supervisory Committee


Work is offered for the degree Master of Science with a major in industrial relations. This is a multidisciplinary degree offered under a cooperative arrangement by the departments of Economics, Industrial Engineering, Political Science, Psychology, and Sociology.

Graduate students in industrial relations usually receive their undergraduate background in economics, business administration, industrial engineering, political science, psychology, or sociology. Admission is not restricted to students from these majors, however. Students preparing for careers in industrial relations ideally should have 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. The student's program of study will be developed with the guidance of an advisory committee selected by the student and the major professor, approved by the chairman of the Industrial Relations Supervisory Committee, and appointed by the dean of the Graduate College. Students may elect the thesis option (consisting of 30 semester-hour credits) or the nonthesis option (consisting of 36 semester-hour credits).

Regardless of which option is taken, all students must take the following core courses: Econ 445, E 424, and Stat 401. For students enrolled in the non-thesis option, the research component of their degree program will be satisfied via the completion of a 3 credit creative component. For students enrolled in the thesis option, the research component of their degree program will be satisfied via the completion of a 6 credit thesis. The balance of the program of study for students in either option will consist of electives from the resident and non-resident courses in the industrial relations curriculum. A minimum of two courses must be taken in three of the five departments comprising the program, with a maximum of four courses in any one department. A minimum of 12 semester credits must be taken from 500-level (or above) courses. In general, the degree program in industrial relations is designed to be as flexible as possible to support the student's own professional interest. Satisfactory completion of a final comprehensive oral examination is required of all students. As part of their graduate education, students enrolled in the non-thesis option in the program have the option of enrolling in an off-campus internship program.

Courses appropriate for the Master of Science degree are determined by the student's advisory committee. Recommended courses for graduate students majoring in industrial relations include: Econ 404, 445, 446, 590B, 595; I E 421, 423, 424, 527, 522, 590, 624; Pol S 420, 421, 425; Info Sci 472, 475, 476/576, 571, 572, 573; Psych 425, 440, 450, 451, 560, 551, 590, 623; Soc 415, 420, 511, 532, 590B, 642; Stat 401, 402. See departmental listings for course descriptions and credits.

The usual prerequisite to major graduate work is the completion of nine semester credits in institution management and six in food and nutrition, and fundamental preparation in accounting, chemistry, and microbiology. The exact requirements will depend upon the field of work the student expects to pursue.

### Courses for Graduate Students, minor only


435. Layout and Equipment. (2-2) Cr. 3. F. Prereq: Credit or classification in 380, 380L. Food facilities planning and design, selection of equipment with emphasis on materials, construction, and specifications. Field trips required. Fee.

437. Automated Foodservice Information Systems. (2-0) Cr. 2. F. Prereq: 344. Application of computer-assisted methods in foodservice organizations through the use of an educational simulation model. Interpretation of computer printouts with emphasis on use of data by management in planning and controlling functions.

438. Personnel Management in Institutions. (3-0) Cr. 3. F. Prereq: Credit or classification in 380, 380L. Functions of management. Principles of personnel organization and management as applied to foodservice and lodging systems. Principles and practices related to personnel recruitment, selection, training, employee-employer relations, and wage administration. Unions, government considerations. Labor and cost control.


460. Legal Aspects of Hotel and Restaurant Management. (2-0) Cr. 2. Alt. F. offered 1982. Prereq: Mgmt 315. Laws relating to ownership and operation of hotels, restaurants, and similar institutions. The responsibility of management and employees to guests and to the public.


### Courses Primarily for Graduate Students, major or minor, open to qualified undergraduates


590. Special Topics and Workshops. Cr. arr. Prereq: Permission of department head. A. Foodservice Management B. Housing Service Management C. General

### Courses for Graduate Students, major or minor

601. Decision Optimization in Institution Management. (4-0) Cr. 4. S. Prereq: 6 semester credits in institution management including 437, college mathematics, statistics recommended. Permission of department head. Application of decision theory in institution foodservice and housing systems, using quantitative methods and programmed decisions. Use of computer as a tool for data analysis.

604. Seminar. Cr. arr. F.S.S.S.

608. Administration Problems. Cr. arr. Prereq:Permission of department head. Consideration of advanced administrative problems. Case studies in foodservice and housing departments of Iowa State University, Memorial Union, and other establishments.

### Journalism and Mass Communication

Robert S. Kahan, Chair of Department

The Graduate Faculty

Members: Hamilton, Hvitvedahl, Schwartz, Shelley, Yarbrough

Associate Members: Abbott, Boyd, Cron, Emmerson, Gillette, Kielbowicz, POLLARD, Scherer

The department offers the degree of master of science with major in journalism and mass communication, and minor work to students taking major work in other departments.

For major work, a student must have a bachelor's degree in journalism in a subject matter area which he or she wishes to combine professionally with advanced training in journalism and mass communication.

Admission of international students is limited to applicants with two types of backgrounds: 1) those engaged in communication or development in such fields as agriculture, home economics, and natural resources in their own country and whose employment indicates a need for specialized training, 2) those who can document at least two years of professional journalism or the teaching of journalism and who wish to improve their professional capability.

### Courses for Graduate Students, minor only

410. Mass Communication. (3-0) Cr. 3. F. S. Prereq: 6 credits in social science. Role of mass media, the scientific processes, methods of measuring, evaluating, and interpreting media effects.

425. Impact of Communication Technology on People and Societies. (2-0) Cr. 2. F. Prereq: Permission of instructor. Seminar on present and potential effects of increasingly sophisticated modes of mass communication on people, institutions, and societies.


431. Background of American Journalism. (3-0) Cr. 3. F.S. Role of the press in shaping the social, economic, and political history of America; impact of change in technology on the development, traditions, and philosophies of the press.

438. Advertising and Public Relations Campaigns. (3-0) Cr. 3. S. Prereq: 345. Development of advertising and public relations campaigns for business and social institutions by projects involving budgeting media selection, market analysis, campaign strategy and practices in preparing the nucleus of a plans book.

440. International Communication and the Foreign Press. (3-0) Cr. 3. F. Prereq: 6 credits in social science. World communication systems, newsgathering and dissemination agencies, the role of foreign correspondents, factors determining flow and volume of world news. Comparative analysis of mass media. International political communication, role of U.S. media in world affairs.

### Institution Management

Marjorie M. McKinley, Head of Department

The Graduate Faculty

Member: Augustine (Emeritus), McKinley

Associate Members: Brown, Finley

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, education, or other related areas.
Landscape Architecture

Albert J. Rutledge, Chair of Department

The Graduate Faculty

Member: Rutledge

Associate Members: Dyas, Harvey, Lane, Roberts, Sinatra

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 within a minimum of 40 credits in residence at Iowa State University. Satisfactory completion of LA 500, 541, 542, 643, 644, or their equivalents, and the acceptance of the 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. Students who cannot qualify with equivalent credits may be required to complete an additional year of study. The department also participates in the interdepartmental minor in Housing. (See Index.)

Library

Warren B. Kuhn, Head of Department

The Library offers a series of non-credit seminars to assist graduate students in the effective use of the Library’s research resources. The seminars cover general materials as well as more specialized ones in the broad areas of the biological and agricultural sciences, the engineering and physical sciences, and the humanities and social sciences. For information and registration consult the Library Reference Department. Offered F.S.S.S.

Linguistics

See English, Foreign Languages and Literatures, and Speech.
Materials Science and Engineering

David R. Wilder, Chair of Department

The department offers work for the degrees of Master of Science (with thesis) and Doctor of Philosophy, with majors in ceramic engineering or metallurgy. Also offered is the Master of Engineering degree (without thesis), with a major in materials science and engineering as well as minor work to students taking major work in other departments. Students majoring in metallurgy may specialize in the areas of physical, chemical, and mechanical metallurgy. Research in the department is closely associated with the Ames Laboratory of the U.S. Department of Energy and the Engineering Research Institute, which provide support for graduate student research assistantships.

Prerequisite to major graduate work is completion of an undergraduate curriculum in physical science or related engineering.

Before admission to candidacy for the degree Doctor of Philosophy with a major in metallurgy, the student is required to demonstrate proficiency in French, German, or Russian by attaining a score of 525 in the Educational Testing Service examination or obtaining a grade of B or better in French 101 and 102; German 101 and 102; or Russian 101 and 102. After satisfying either of the above requirements, the student must translate one journal article per quarter for three consecutive quarters; the articles are translated by a professor.

There is no departmental foreign language requirement for students seeking the degree Doctor of Philosophy with a major in ceramic engineering. However, students are encouraged to include the study of a foreign language as part of their program.

Because nuclear energy technology is an important application of materials, there is a cooperative arrangement with the Department of Nuclear Engineering. Students with majors in the Materials Science and Engineering Department interested in nuclear energy technology are encouraged to consider the following courses.

Nuc E 401, 451, 471, 484, 535, 541, 582; M S E 375, 551, 552, 650

The department participates in the Energy Systems Engineering minor program and the interdisciplinary program of Technology and Social Change. (See Index)

Courses for Graduate Students, minor only

301, 302. Physical Metallurgy. (4-0) Cr. 4 each. Yr: Prereq: 301, 231 or 270 or 271, 302, 301, 301.

301L. Metallurgy Laboratory. (0-6) Cr. 2. F. Prereq: Credit or classification in 301. Preparation and analysis of ferrous and non-ferrous metals. Quantitative optical microscopy, scanning electron microscopy, powder X-ray diffraction, hardness testing.

302L. Physical Metallurgy Laboratory, (0-6) Cr. 2. S. Prereq: Credit or classification in 302. Experiments are carried out and analyzed which involve the following topics: Carburation treatment of gray, ductile, and nodular cast iron; Jominy end quench, induction hardening; x-ray and metallurgical evaluation of retained austenite, age hardening, precipitation hardening, and welding of plain carbon and stainless steels.


343. Electronic Ceramics, (3-0) Cr. 3. S. Prereq: 231. Phys 222. Underlying causes and characteristics of electrical and magnetic behavior of ceramic materials. Properties and production of common ceramic materials used for dielectric, optical, semiconducting, and magnetic applications.


360. Thermochromy for Materials Science and Engineering, (3-0) Cr. 3. F. Prereq: Chem 167 or 177, Math 266. Basic laws of thermodynamics applied to materials systems. Thermodynamic properties of pure substances, homogeneous and heterogeneous equilibria. Property change s for chemical reactions.


370. Principles of Nondestructive Testing, (E M 370). (3-4) Cr. 3. S. Prereq: Phys 112 or 222. Radiography, ultrasonic testing, magnetic particle inspection, eddy current testing, dye penetrant inspection and other less common techniques. Physical bases of test material s to which applicable, types of defects detectable, calibration standards, and safety precautions.


381, 401. Mechanical Metallurgy. (3-0) Cr. 3 each. F. S. Prereq: 301, 302, 401, 402. Stress-strain, elastic and plastic deformation, testing methods and principles, creep and stress rupture, strengthening mechanisms. 420. Fracture mechanics, metal forming processes, failure analysis, codes and standards.

402L. Mechanical Metallurgy Laboratory, (0-6) Cr. 2. S. Prereq: Credit or classification in 402. Tension and impact testing, residual stresses, creep, stress rupture, and fatigue tests.

410. Physical Metallurgy, (3-0) Cr. 3. F. Prereq: Chem 167 or 177, Math 266. Introduction to physical metallurgy for seniors or graduate students in science or engineering who have little or no prior preparation in materials science.


441. Refractories, (3-0) Cr. 3. S. Prereq: 360, 382, 345. Mineralogy, manufacture and service characteristics of the refractories used in metallurgical and ceramic industries.


Courses Primarily for Graduate Students, major or minor, open to qualified undergraduates.


520. Chemical and Physical Metallurgy of Rare Earths, (2-0) Cr. 2. Alt. F. offered 1982. Prereq: 302 or 410 or Phys 355, 360 or Chem 321. Electronic configuration, valence states, minerals, ores, beneficition, extraction, separation, metal preparation and purification, crystal structure, transformation, melting and boiling points, chemical behavior, inorganic compounds, alloy chemistry, and sintering of the chemical bond, mechanical and elastic properties, magnetic properties, resistivity, and superconductivity.


522. Structure, Properties and Heat Treatment of Ferrous and Non-ferrous Alloys, (3-0) Cr. 3. F. Prereq: 332 or 331 or 410. Application of fundamental concepts of phase transformations, heat flow, mechanical behavior, and structure-property relations to the problems of heat treatment and selection of steels and aluminum, copper and titanium alloys.
523. Corrosion and Oxidation. (2-0) Cr. 2. F. Prereq: 360 or Chem 321. Study of origin, development, and fundamental and applied theories of corrosion and oxidation of metals.


525. X-Ray Diffraction. (3-0) Cr. 3. S. Prereq: 301 or 344 or 410. Introduction to theory of x-ray and neutron diffraction; symmetry operations, space groups and reciprocal lattice. Laue and power diffraction methods and their application to precise lattice parameters, determination of simple crystal structures, phase identification, orientation, texture, grain size, strain, residual stress and order-disorder. Chemical analysis by x-ray method and small angle scattering.


590. Equilibrium and Nonequilibrium Ceramic Systems. (Nuc E 552) (3-0) Cr. 3. Offered as: Prereq: 551. Introduction to classical thermodynamics, introduction to irreversible thermodynamics, phase transformation and phase equilibria in ceramic systems.

591. Ideal and Defect-Containing Crystaline Compounds. (3-0) Cr. Offered as: Prereq: 231 or 370. 345. Crystal chemistry of oxides and other inorganic compounds. Crystal structure and properties relations using ideal structures and structure containing point defects such as Schottky and Frenkel defects plus defects created by non-stoichiometry and doping.

593. Measurements in High Temperature Systems. (2-0) Cr. Offered as: Prereq: 360 or Chem 321. Theory and practice of analysis of measurement at elevated temperatures. Furnaces and techniques for determination of mechanical, thermal, and chemical properties of high temperature materials.

597. Vitreous State. (3-0) Cr. Offered as: Prereq: 442 or 360 or Chem 321. Advanced theory of the vitreous state. Structure of glasses, nucleation theory, control of devitrification, composition-structure-property relationships.


596. Special Topics. Cr. Var. Prereq: Permission of instructor.

597. Topics in Material Science. Cr. 1 to 3 each time offered. CR: Prereq: Permission of instructor.

600. Microstructural Studies. F. Mechanical properties of Ceramic Materials

Courses for Graduate Students, major or minor


690. Advanced Topics. Cr. Var. Prereq: Permission of instructor.

A. Creative Component
B. Other

695. Advanced Topics in Material Science. Cr. 1 to 3 each time.

A. X-ray Scattering From Crystals
B. Alloy Theory
C. Metallurgical Thermodynamics

699. Research.

Mathematics

Wilfred E. Barnes; Head of Department

The Graduate Faculty

Members: Abatzoglou, Epstein, Boghet, Homen, Kegley, Lindahl (Emeritus), Madu, Meany, Nelson, Peake, Pierig, Rudolph, Sprague

The department offers work for the degrees M.S. in Science, and Doctor of Philosophy with majors in mathematics or 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 12 semester credits of work in mathematics beyond calculus. It is desirable that this include advanced calculus and abstract algebra.

The M.S. degree 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. All written, oral, and written exams are given in English, except for those written in 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 at the recommendation of the student's program of study committee and approval of the department head.

Courses for Graduate Students, minor only


307. Theory of Matrices. (3-0) Cr. 3. F. S.S.S. Prereq: 1 semester of calculus. The algebra of matrices including vector spaces, simultaneous linear equations, determinants, quadratic forms, eigenvalues, and diagonalization over the real and complex numbers.

308. Application of Linear Algebra to Discrete Optimization. (3-0) Cr. 3. S. Prereq: 270 or 302 or 307. Linear programming and topics chosen from game theory, transportation and assignment problems, discrete dynamic processes, and multiple objective linear programming.

331, 332. Topology. (3-0) Cr. 3 each. Yr. Prereq: 331: 265 or 270, 332. Topological properties of metric spaces with emphasis on "," sequences, continuity, functions, completeness, compactness. Abstract topological spaces and related properties, including compactifications, connectedness and fundamental groups.

365. Complex Variables with Applications. (3-0) Cr. F. S. Prereq: 265 or 371. Functions of a complex variable, including differentiation, integration, and series expansions, residues, evaluation of integrals, conformal mapping.

365. Introduction to Partial Differential Equations. (3-0) F. S. Prereq: 265 or 371. Fourier series, separation of variable methods, Bessel series and Legendre polynomials, introduction to Sturm-Liouville theory.

Courses Primarily for Graduate Students, major or minor

504. 505. Abstract Algebra. (3-0) Cr. 3. Each. Yr. Prereq: 302. Algebraic systems and their morphisms, including groups, rings, and linear algebra.


510. Linear Algebra. (3-0) Cr. 3. F. Prereq: 302 or 307. Brief review of elementary linear algebra, followed by advanced topics, canonical forms, inner product spaces, bilinear forms, tensor products, and applications in geometry and applications of mathematics.


514. 515. Real Analysis. (3-0) Cr. 3 each. Yr. Prereq: 415. Basic concepts of topological spaces, function spaces, measure and integration.


528, 529. Special Functions. (3-0) Cr. 3 each. Yr. Prereq: 365. Gamma and beta functions; classical polynomials, Legendre and Bessel functions, elliptic integrals, and other functions of hypergeometric type. A unified treatment of the special functions arising in applied mathematics.


534, 535. Topology. (3-0) Cr. 3 each. Yr. Prereq: Permission of instructor. Introduction to general topology and several variables. Newton’s method in several variables.

541. Numerical Solution of Differential Equations and Interpolation. (Com S 481) (3-0) Cr. 3. F. SS. Prereq: 270 or 265 and one of 266, 267, knowledge of FORTRAN. Computational error, solutions of linear systems, least square methods, similarity methods for eigenvalues, non-linear equations, fixed point iteration, and several variables. Newton’s method in several variables.


564. Theory of Groups. (3-0) Cr. 3. S. Prereq: 505. Commutators, p-groups, nilpotent groups, solvable groups, free groups, free semigroups, introduction to representation theory.

567. Boolean Rings. (3-0) Cr. 3. S. Prereq: Permission of instructor. Structure of semisimple commutative rings and their representations. Primary and completely primary Stone space of Boolean rings. The field of Boore and Baire sets. Theorems on extension of homomorphisms. Applications to Boolean algebras, rings, and measure theory.


581, 582. Axiomatic Set Theory. (3-0) Cr. 3 each. Yr. Prereq: Permission of instructor. Axiomatic set theory, model and proof theory, Zermelo-Fraenkel axioms, classical theorems, transfinte methods, ordinal and cardinal numbers and their arithmetic, Von Neumann-Bernays-Godel axioms, inaccessible cardinals, consistency and independence results of Godel, Cohen, and others, method of forcing.


590. Special topics. Cr. var.

Courses for Graduate Students, major or minor

610. Seminar.

690. Advanced Topics. Cr. var. Prereq: Permission of instructor.

Mechanical Engineering

Artur E. Bergles, Chair of Department

The Graduate Faculty

Members: Bahadur, Baumgarner, Bergles, Black, Cook, Hall, Junn, Mischke, Okishi, Porter, Seshy, Wilson, Woods

Associate Members: Colver, Felling, Henkin, Joensen, Kuehn, Peters, Shapiro

The department offers work for the degrees Master of Science, and Doctor of Philosophy with major in mechanical engineering, and minor work to students taking major work in other departments. Course offerings may be used in co-major or minor programs for students of other departments.

At the time of admission graduate students who have not completed an undergraduate program of study substantially equivalent to that required of undergraduate students in the department can expect that additional supporting course
work, as determined by their program of study committee, will be required.

The graduate program emphasizes advanced study, including design and research, in such areas as fluid mechanics and turbomachinery, fluid power and controls, heat transfer, machines and systems, materials and manufacturing processes, and thermodynamics and energy utilization. Instrumentation and design of experiments are applied to all of these areas. Relational, dynamic, environmental, materials, and legal considerations in design are emphasized. The department participates in the interdepartmental minor program of Energy Systems Engineering (See Index.) The department encourages students to broaden their education by participating in minor programs in established departments, interdepartmental programs, or such other experiences as approved by their program of study committees.

The requirements for advanced degrees are established by the student’s program of study committee. A foreign language requirement exists only for Doctor of Philosophy when the student’s program of study committee deems it appropriate to a specific program of study. It is possible to arrange a program of study for the Master of Science on a nonthesis basis.

Courses for Graduate Students, minor only
311. Mechanical Systems, (2-2) Cr. 3 F. S. SPr 310, Math 267, E E 441. The basic principles of structure of solids to the study and control of mechanical properties. Qualitative and quantitative analysis of structures between microstructure and mechanical properties.
321. Mechanical Behavior of Materials, (MS 321) (2-2) Cr. 3 F. S. SPr 310, Math 544, E E 441. Application of the basic principles of structure of solids to the study and control of mechanical properties. Qualitative and quantitative analysis of structures between microstructure and mechanical properties.
311. Industrial Automatic Controls, (2-2) Cr. 3 S. SPr 311, Methods and principles of automatic control. Pneumatic, hydraulic, and electrical systems. Representative applications of automatic control systems. Mathematical analysis of control systems.
412. Legal and Environmental Considerations in Design, (3-0) Cr. 3 F. SPr 312, senior classification in engineering. Failure modes associated with product environment. Interaction between the legal profession, legislative bodies, and the design engineer, using a case study approach in design applications. Litigation involving designs, standards, and laws applicable to specific designs surveyed. The influence of laws and standards upon design.
414. Hydraulic Systems and Control, (3-0) Cr. 3 S. SPr 311, 332, Characteristics and design of pumps. Hydraulic motors, system components, system analysis, feedback control and stability, control circuits, analog simulation.
411. Refrigeration and Air Conditioning, (3-0) Cr. 3 F. SPr 327. Credit or classification in 336 or 436. Fundamentals of vapors, absorption, thermoelectric and air refrigeration systems. Cryogenic cycles used to liquify and separate gases. Applications to the processing, low temperature storage, and superconducting systems.
443. Thermal Power Plants, (4-0) Cr. 4 F. E E 351 or 447. Introduction to thermodynamics. Power plant cycles, fossil fuel electric generating station components, steam generators, steam and gas turbines, condensers, cooling towers and plant auxiliaries.
444. Elements and Performance of Power Plants, (3-0) Cr. 3 F. SPr 332, credit or classification in 436. Analysis of power supply systems and their components. Feeders, transformers, fans, pumps, heat exchangers, cooling water systems. Environmental pollution and control.
446. Power Plant Design, (2-3) Cr. 3 S. SPr 444. Design of a power plant to meet a specified power (energy) demand. Selection and synthesis of principal components and pollution control equipment.
412. Gas Turbines, (2-0) Cr. 2 S. SPr 332, 335. General principles, thermodynamics and performance of gas turbine engines. Engine components, engine materials and selection of physical properties.
448. Fluid Dynamics of Turbomachinery, (2-3) Cr. 3 S. SPr 335. Applications of principles of fluid mechanics and thermodynamics in performance analysis of turbomachinery and related fluid system components. Design problems.
460. Experimental Engineering, (3-0) Cr. 1 F. SPr 332, 360, 436. Experimental investigation of selected practical problems. Application of fluid mechanics, heat transfer and applied areas of mechanical engineering. Emphasis on application of classroom and experimental engineering and on interpretation and presentation of the results.
470. Computer-Aided Design, (3-0) Cr. 3 F. SPr 332. Senior classification in engineering and an elementary knowledge of FORTRAN. An examination of the morphology of design processes, the structure of the FORTRAN language, figures of merit, searching and optimization.bahwasa, leading to an algorithmic approach to design.
475. Numerical Methods in Mechanical Engineering, (3-0) Cr. 3 F. SPr 332, 360, 436. Numerical solution of techniques of computational mechanics problems, including those governed by ordinary and partial differential equations. Digital computer applications to problems drawn primarily from thermal and mechanical systems.

Courses for Interdepartmental Minor in Mechanical Engineering
510. Dynamics of Fluid Control Systems, (3-0) Cr. 3 F. SPr 335, 411. Dynamical characteristics of fluid control systems and elements.
515. Advanced Design of Machine Elements, (3-0) Cr. 3 F. SPr 332. Introduction to computer assisted design, and rational methods for analysis and synthesis of the solution of advanced design problems in machine elements. Creep and fatigue considerations.
516. Kinematic Analysis and Synthesis of Mechanisms, (3-0) Cr. 3 F. SPr 410. Analysis and synthesis of mechanisms using graphical, analytical, and computational methodologies.
521. Properties of High Polymers, (M S 521) (3-0) Cr. 3 S. SPr 327 or 271. Molecular structure and packing, polymer viscoelasticity, thermodynamics, mechanical properties. Effects of chemical structure and morphology on mechanical properties emphasized, and engineering aspects discussed.
525. Friction and Wear, (3-0) Cr. 3 F. SPr 327 or 271. E M 324. Structure of solid surfaces, surface energetics and adhesion. Thesories of friction. Forms of wear and relationship to microstructure and properties. Effect of lubrication on friction and wear. Tire and brake performance. Friction in deformation processing.
526. Forming Processes, (3-0) Cr. 3 F. SPr 327 or M S 320. Concepts in continuum mechanics and physical metallurgy applied to the study of forming processes and their effect on the properties of the manufactured product.
531. Statistical Thermodynamics for Engineers, (3-0) Cr. 3 F. SPr 332, 343. F. SPr 1963. First and Second Laws of Thermodynamics, properties of gases, liquids, and solids from a microscopic viewpoint. Introduction to non-equilibrium thermodynamics. Chaos, relationships and determination of transport properties.


535. Hydrodynamic Lubrication. (3-0) Cr. 3. F. Prereq: 312, 335. Theory of fluid film lubrication and application to bearing design.

536. Advanced Heat Transfer. (3-0) Cr. 3. S. Prereq: 336 or 436. Advanced treatment of heat transfer by conduction, convection and radiation. Intended for those who require a general coverage of theory and methods but whose primary research interests are in other areas.

537. Experimental Fluid Mechanics. (E M 537) (1-3) Cr. 2. S. Prereq: 571. Experimental aspects of fluid mechanics including fundamentals of measurement of flow field velocities, pressures, and temperatures.

540. Solar Energy Thermal Systems. (3-0) Cr. 3. S. Prereq: 536 or 436. Application of heat transfer and thermodynamics to the design and analysis of solar energy collectors and systems.


545. Vehicular Propulsion Systems. (3-0) Cr. 3. S. Prereq: 532 and 548 or Aer E 412. Analysis and selection of propulsion systems for vehicles.

546, 547. Computational Fluid Mechanics and Heat Transfer I, II. (Aer E 546, 547) (3-0) Cr. 3 each. Yr. Prereq: 546: credit or classification in 571 or Aer E 451; 547: 546, 546. Introduction to finite difference methods used in modern engineering. Solution of example problems in fluid mechanics and heat transfer. 547: Application of computational methods to current problems in fluid mechanics and heat transfer.


560. Design of Engineering Experiments I (2-3) Cr. 3. F. Prereq: Graduate standing, 1 undergraduate engineering laboratory course and elementary knowledge of fundamentals of design selection and operation of instrumentation components of measuring systems. Techniques for analysis, interpretation, and presentation of experimental data. Error analysis and propagation of error. Statistical inference acceptance tests and comparison tests, precision and confidence limits on data resulting in points, lines, or curves.

561. Design of Engineering Experiments II (3-0) Cr. 3. Alt. S., offered 1982. Prereq: 360 or 560. Design of experiments to determine what data to take, how much data to take, as well as to meet prescribed confidence limits on results. Selection of complete measurement systems to satisfy the response, sensitivity, resolution, isolation, and fidelity required by specifications of the experiment.

564. Fracture and Fatigue. (E M 564, M S E 564) (3-0) Cr. 3. F. Prereq: E M 324 and any one of E M 337, E Sci 562, M S E 231, 270 or 271. Materials and mechanical approach to fracture and fatigue. Fracture mechanics, brittle and ductile fracture, fracture and fatigue characteristics. Fracture and fatigue tests, thermal fracture, mechanics and materials designed to avoid fracture and fatigue.


590. Special Topics. 1 to 9. Investigation of problems of special interest to graduate students in mechanical engineering. Election of course and problem must be approved in advance. A. through G., J. through L. (See listing under 490.)

Courses for Graduate Students, major or minor

600. Seminar. (1-0) Cr. R. F.

602. Advanced Machine Design. (3-0) Cr. 3. Prereq: At least two of 510, 514, 515, 516, 518, E M 514, 517, 544. Concepts, principles, theories, and procedures useful for synthesis decisions in advanced mechanical design including computational aids with emphasis on high speed applications. Choice of work determined by aptitudes and interests of the class and instructor.


650. Fluid Mechanics Seminar. (Aer E 650, E 650) (1-0) Cr. 1 each time taken. F. Prereq: Permission of instructor. Special topics of current research interest to students and staff of departments concerned.


690. Advanced Topics. Cr. Var.

699. Research.

*Credit for both 530 and 630 may not be applied toward graduation.

Metallurgical Engineering

For description of courses, see Materials Science and Engineering.

Metallurgy

For description of courses, see Materials Science and Engineering.

Meteorology

For description of courses, see Earth Sciences.

Microbiology

(Bacteriology)

Paul A. Hartman, Chair of Department

The Graduate Faculty

Members: Atherly, Durand, Glatz, Hartman, Holt, Kraft, Lockhart, Pattee, Quinn, Walker, Williams

Associate Member: Loinachan

The department offers work the degrees Master of Science and Doctor of Philosophy with major in microbiology, and minor work to students majoring in other departments. Within the major the student may specialize in microbiology; in virology, in food, applied, medical, or systematic bacteriology; or in microbial ecology, genetics, physiology, or morphology. Major graduate study in primary microbiology, soil microbiology, and dairy microbiology is offered in the departments of Veterinary Microbiology, Agromony, and Food Technology, respectively.

Specific prerequisite to major work in microbiology is the completion of thorough course work in general microbiology, biology, organic chemistry, biochemistry, mathematical sciences, and physics. Minor study usually is selected from chemistry, biochemistry and biophysics, botany, zoology, genetics, mathematics, computer science, and statistics.

The department also participates in the interdepartmental programs in immunobiology, Molecular, Cellular and Developmental Biology; and Water Resources (see Index).

Each graduate student must have received a grade of B or better in English composition or pass the Graduate English Examination within two semesters in residence.

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. Graduate students are encouraged to teach at least one laboratory section each year in residence.
Courses for Graduate Students, minor only

310. Pathogenic Microbiology. (3-4) Cr. 4. FSS. Prereq: 300, a course in organic chemistry. Study of pathogenic bacteria and other microorganisms. Clinical laboratory techniques for the identification and characterization of pathogens.

320. Advanced General Bacteriology. (3-6) Cr. 5. S. S. Prereq: 300, a course in organic chemistry. A survey of the procaryotes with emphasis on bacterial physiology, cytology and ecology. The isolation, cultivation, and study of bacteria.

400. Molecular Biology of Bacteria and Viruses. (3-0 or 3-4) Cr. 3 or 4. F. Prereq: 300, Gen 330. Survey of bacterial, plant and animal virology. Emphasis on bacterial genetics and virus-host-cell interactions. Laboratory emphasizes mutagenesis and genetic characterization of bacteria and principles and techniques involved in the quantification, isolation and characterization of bacteriophages.

401. Food Processing. (F Tch 401) See Food Technology.

402. Food Processing Laboratory. (F Tch 402) See Food Technology.

420. Food Microbiology. (F Tch 420) (3-0) Cr. 3. F. Prereq: 300. The normal microbial flora of foods, microbiological indicators of contamination, food-borne infections and intoxications; food safety.

421. Food Microbiology Laboratory. (F Tch 421) See Food Technology.

425. Food and Water Sanitation. (F Tch 425) See Food Technology.


Courses Primarily for Graduate Students, major or minor, open to qualified undergraduates


508. Vertebrate Virology. (2-0 or 2-4) Cr. 2 or 3. S. Prereq: 400, permission of instructor required for laboratory. Molecular biology and pathology of vertebrate viruses. Laboratory emphasizes the isolation, quantification, and characterization of vertebrate viruses.


520. Medical Immunology I. (VMPM 520, Imbio 520) See Veterinary Microbiology and Preventative Medicine.

524. Veterinary Medical Mycology. (VMPM 524) See Veterinary Microbiology and Preventative Medicine.

525. Applied Microbiology. (3-0) Cr. 3. S. Prereq: 300. Permission of instructor. Utilization of microorganisms in agriculture and industry.


550. Seminar. Cr. 1 each time taken. F.S. Required of all students taking major graduate work in microbiology. Offered on a satisfactory-fail basis only.

560. Immunoparasitology. (Vet Ph 560) See Veterinary Pathology.

575. Immunology. (Imbio 575) (3-0 or 3-9) Cr. 3 or 5. F.S. Prereq: 300, laboratory by permission of instructor. Theories of immunity and immunization, antigen-antibody reactions. Laboratory deals with preparation and use of vaccines and antiserum, immunological techniques.


Courses for Graduate Students, major or minor

600. Comparative Anatomy and Physiology of Bacteria. (3-0 or 3-3) Cr. 3 or 4. F. Prereq: Course in microbiology and biochemistry. Metabolism, growth and cultivation of bacteria; structure of bacteria as related to function. Laboratory emphasizes the cultivation and manipulation of bacteria as research tools for the study of comparative physiology and molecular biology.

610. Genetics of Bacteria and Bacteriophage. (2-0 or 2-4) Cr. 2 or 4. S. Prereq: Course in microbiology and genetics. Advanced course in genetics and molecular biology of bacteria and viral pathogens. Laboratory is a continuation of Bact 690 laboratory.


615. Molecular Immunology. (B B 615) See Biochemistry and Biophysics.

620. Molecular Genetics. (Gen 620) See Genetics.

626. Advanced Food Microbiology. (F Tch 626) See Food Technology.


690. Advanced Topics. Cr. 1 to 5 each time elected. Prereq: Permission of instructor. Selected topics of current interest.

698. Seminar in Molecular, Cellular, and Development Biology. (MCD 698) See Molecular, Cellular, and Development Biology.

699. Research.

*Molecular Genetics. (Gen 620) See Genetics.

626. Advanced Food Microbiology. (F Tch 626) See Food Technology.


690. Advanced Topics. Cr. 1 to 5 each time elected. Prereq: Permission of instructor. Selected topics of current interest.

698. Seminar in Molecular, Cellular, and Development Biology. (MCD 698) See Molecular, Cellular, and Development Biology.

699. Research.

Work is offered for the degrees Master of Science and Doctor of Philosophy with major in molecular, cellular, and developmental biology in several cooperating departments: Animal Science, Biochemistry and Biophysics, Botany, Food Technology, Genetics, Microbiology, and Zoology.

Facilities and qualified faculty are available in these departments for conducting fundamental research in the three focal areas of the program: structure and function of muscle, mechanisms of information storage and transfer, cell interactions and membranes. Ongoing research involves studies with viral, prokaryotic, and eukaryotic systems.

Students majoring in molecular, cellular, and developmental biology will become affiliated with a department and choose a major professor from the participating faculty in that department. All Ph.D. students take a core curriculum consisting of the following courses: one year of basic graduate botany (B B 404, 405 or B B 501) molecular genetics (Gen 620 or Micro 610) cell biology (B B 526 or Zool 528), developmental biology (B B 675, Gen 619, Zool 534 or Zool 631) and seminar in MCD 698 (MCD 698). M.S. students take the above core but may delete either the molecular genetics, cell biology, or developmental biology complement. Additional course work is selected to meet departmental requirements and to satisfy individual student research interests; courses may be chosen from those listed below. The foreign language requirement is determined by the student's major department.

All graduate students are required to teach as part of their training for an advanced degree.
programs in engineering or in the physical sciences. It is recommended that students contemplating graduate study in nuclear engineering include courses in modern physics, heat transfer, thermodynamics, chemistry, and mathematics (both ordinary and differential equations) as part of their undergraduate preparation.

Admission to the EAC/ABET-accredited Master of Engineering program is restricted to those students having a bachelor’s degree from an EAC/ABET-accredited engineering curriculum or the equivalent.

For the degree Doctor of Philosophy, a foreign language may be required by the student’s program of study committee.

Because materials are an important aspect of nuclear engineering, there is an interdisciplinary arrangement with the Department of Materials Science and Engineering. Nuclear engineering students interested in materials aspects of nuclear energy technology are encouraged to consider the following courses: M S E 375, 401, 402, 520, 522, 551, 552, and 650.

The department also participates in the interdisciplinary minor programs of Energy Systems Engineering, Water Resources, and Technology and Social Change. (See Index.)

Courses for Graduate Students, minor only


484. Nuclear Radiation Engineering. (3-0) Cr. 3. Prereq: 221. Nuclear engineering applications other than those oriented towards large scale power production. Isotopic power sources. Radiation gauging. Biomedical, agricultural, and chemical industry uses of radiation. Neutron radiography and activation analysis.

Courses Primarily for Graduate Students, major or minor, open to qualified undergraduates


585. Nuclear Power Plant System Design. (1-4) Cr. 3. Prereq: Credit or classification in 521. Preliminary design of nuclear power plants. A group project with individual component or system design and integration into the total project. Component selection, trip wiring, shielding, siting, licensing, engineered safeguards, and economic considerations.

590. Special Topics. Cr. var. Topics of special interest in nuclear engineering.
Courses for Graduate Students, major or minor
661. Advanced Nuclear Engineering Laboratory. (3-3) Cr. 3. S. Prereq: Credit or classification in 532, 561, 582. Performance evaluation of nuclear systems using standard and experimental measurement methods.
690. Advanced Topics. Cr. var.
695. Advanced Seminar. (1-0) Cr. R. F. S. Presentations and discussions of advances and problems in contemporary nuclear engineering.
699. Research.

Philosophy
John W. Elrod, Chairman of Department

The Graduate Faculty

Members: Elrod, Hollinger, Klenke, Kupfer, Robinson, Solomon, Van Iten

Associate Members: Hollenbach, Kline

The department offers courses for graduate minor work in philosophy and participates in the interdepartmental programs in General Graduate Studies and Technology and Social Change. (See Index.)

Courses for Graduate Students, minor only
310. Ancient and Medieval Philosophy. (3-0) Cr. 3 or (3-1) Cr. 4. F. Prereq: 201. Plato's and Aristotle's metaphysics and epistemology, related to their moral and social theory. Some representative medieval philosophers such as Augustine and Aquinas, and such problems as free will and the existence of God.
311. Modern Philosophy. (3-0) Cr. 3 or (3-1) Cr. 4. S. Prereq: 201. Philosophy from the late Renaissance to the late 18th Century. Our beliefs about our world, ourselves and our society. The nature of doubt and certainty, sources of knowledge and illusion.
312. 19th and 20th Century Continental Philosophy. (3-0) Cr. 3 or (3-1) Cr. 4. F. Prereq: 201. Hegel's philosophy and various responses to this philosophical position. Developments in phenomenology (e.g., Husserl, Heidegger, and Merleau-Ponty), existentialism (e.g., Kierkegaard, Nietzsche, and Sartre), and social and political philosophy (e.g., Marx and Habermas).
313. Twentieth Century Anglo-American Philosophy. (3-0) Cr. 3 or (3-1) Cr. 4. S. Prereq: 201. Main problems and themes of major movements in contemporary philosophy such as pragmatism, realism, common sense philosophy, logical positivism, and ordinary language philosophy. Readings include key works by representatives of these positions.
320. Existentialism. (3-0) Cr. 3 or (3-1) Cr. 4. F. Prereq: 201. Philosophical foundations of existentialism: Kierkegaard, Nietzsche, and Heidegger. Its religious, literary, and psychoanalytic expressions: Dostoevsky, Tolstoy, Tocilch, Buber, Marcel, Camus, Pursey, May, and Lang.
323. Philosophy of Law. (3-0) Cr. 3 or (3-1) Cr. 4. Alt. S., offered 1980. Prereq: 201 or 203. Extent of our obligation to obey the law; what constitutes just punishment; how much of the immoral should be made illegal? Relation of these questions to many theories of law and the state. Discussion of such concepts as coercion, equality, and responsibility.
335. Social and Political Philosophy. (3-0) Cr. 3 or (3-1) Cr. 4. F. Prereq: 201. Foundations of social and political life. Metaphysical and epistemological grounds in classical and recent thinkers. The basis of political organization, the nature of social and political institutions, rights and justice and the character of distinctly political action. Original texts.
340. Aesthetics. (3-0) Cr. 3 or (3-1) Cr. 4. F. Prereq: 201 or 203. Is liking anything there to appreciating anything of art or as in general culture? We will examine these important questions, talk about such experiences, e.g., art criticism, and what makes them valuable. Do the different arts have common values? How are their differences important? Do different media have different values?
350. Philosophy of Religion. (Relig 350) (3-0) Cr. 3 or (3-1) Cr. 4. S. Prereq: 201. The value and truth of religious life and belief. Mystical experience: religious faith and language: arguments for God's existence; the problem of evil; miracles, and religion and morality. Historical and contemporary readings from both the western and eastern traditions.
360. Philosophy of Science. (3-0) Cr. 3 or (3-1) Cr. 4. F. Prereq: 201. Introduction to philosophy of science. A variety of basic problems common to the natural and social sciences: the nature of explanation, the structure of theories, the unity of science, and the distinction between science and non-science.
381. Philosophy of the Social and Behavioral Sciences. (3-0) Cr. 3 or (3-1) Cr. 4. S. Prereq: 201 or 6 credits in the social sciences. An examination of conflicting approaches to the study of human behavior, as represented by the social and behavioral sciences. Conflicts between different approaches against the backdrop of conflicting scientific method. Similarities and differences between the social and natural sciences, as well as among the various social and behavioral sciences. Assumptions about the nature of human beings, values and societies, the value-neutrality of the social sciences and the ideological dimensions of the policy sciences. Selections from social scientists and philosophers.
430. Seminar: Value Theory. (3-0) Cr. 3 each time taken, maximum of 6 credits. S. Prereq: 230. Theoretical and normative issues in ethics, aesthetics, religious thought and political philosophy. Topics vary each time offered.
460. Seminar: Epistemology and Metaphysics. (3-0) Cr. 3 each time taken, maximum of 6 credits. Alt. F., offered 1981. Prereq: 201 and at least one course in the history of philosophy. Issues in epistemology and metaphysics. Topics vary each time offered.
470. Seminar: Philosophical Systems. (3-0) Cr. 3 each time taken, maximum of 6 credits. Alt. F., offered 1982. Prereq: 201 and at least one course in the history of philosophy. Focus upon philosophical systems; analysis of several philosophers forming a tradition or school, or a single philosopher who offers a comprehensive system. Topics vary each time offered.
500. Special Topics in Philosophy. Cr. 2 to 4 each time taken. Prereq: Permission of instructor; 9 credits in philosophy.
A. History of Philosophy
B. Epistemology and Metaphysics
C. Value Theory
D. Logic and Philosophy of Science

*Optional fourth credit entails guided research or other complementary study.

Religious Studies
Richard J. Van Iten, Chair, Advisory Committee


The program offers courses for graduate minor work in religious studies as supporting work for other fields.

321. The Old Testament. (3-0) Cr. 3 or (3-1) Cr. 4. F. Prereq: 1 200-level course in religious studies. Literature and religion of ancient Judaism understood within the context of ancient Near Eastern cultures. Particular attention given to the development of basic religious and ethical perspectives and their modern relevance.

322. The New Testament. (3-0) Cr. 3 or (3-1) Cr. 4. S. Prereq: 1 200-level course in religious studies. Literature and religion of early Christianity within the context of contemporary Judaism and Hellenistic culture. Particular attention given to the development of basic religious and ethical perspectives and their modern relevance.


353. Ways of Enlightenment: Hinduism and Buddhism. (3-0) Cr. 3 or (3-1) Cr. 4. F. Prereq: 1 200-level course in religious studies. The various Hindu and Buddhist paths to realize enlightenment and freedom. Special attention to meditation and yoga and their relationship to altered states of consciousness and Western methods of psychophysical integration.

365. Western Religious Thought. (3-0) Cr. 3 or (3-1) Cr. 4. S. Prereq: 1 200-level course in religious studies. An examination of the religious and intellectual upheaval of the Reformation against its Medieval background and its subsequent development. Focus on a critical and sympathetic understanding of the major theological, philosophical, and historical forces which form contemporary Judaism, Catholicism, and Protestantism.

465. Seminar: Contemporary Western Religious Thought. (3-0) Cr. 3 or (3-1) Cr. 4. F. Prereq: 6 credits in religious studies. Selected topics in contemporary religious thought including Protestant, Roman Catholic, Jewish, and secular thinkers.

475. Seminar: Issues in the Study of Religion. (3-0) Cr. 3 each time taken, maximum of 6 credits. S. Prereq: 230. Theoretical and normative issues in ethics, aesthetics, religious thought, and political philosophy. Topics vary each time offered.

590. Special Topics in Religious Studies. Cr. 2 to 4 each time taken. Prereq: Permission of instructor; 9 credits in philosophy.
A. Western Religions
B. Eastern Religions
C. Religious Thought
D. Religion and Culture

*Optional fourth credit entails guided research or other complementary study.

Nuclear Engineering and Physics

Physical Education and Leisure Studies

Barbara E. Forker, Head of Department

The Graduate Faculty

Member: Forker

Associate Members: Dean Anderson, Beran, Conover, Frye, Hutchinson, Mathes, Pease, Puhl, Rupnow, Woud

The department offers work for the degree Master of Science with major in physical education and minor work to students taking major work in other departments. The normal prerequisite to major graduate work is the satisfactory completion of a curriculum
essentially equivalent to that required of undergraduate students in physical education at this University. However, it is possible for students to qualify for graduate study even though undergraduate preparation has been in a related area. A student in the graduate program may select either a thesis or non-thesis option. Specific information about the requirements for either degree option is available from the department office.

**Courses for Graduate Students, minor only**

**Leisure Studies (L S)**
355. Dimensions of Recreation in the Campus Community. (3-0) Cr. 3 F.S. Prereq: 350. Basic concepts in organization, administration, and program planning of recreation in the campus community.


**Courses Primarily for Graduate Students, open to qualified undergraduates**

580. Theory and Philosophy of Leisure. (3-0) Cr. 3 Prereq: Admission to graduate study or related areas. Theoretical and philosophical development of the leisure concept with application to the professional field of service. Historical development of theory and philosophy.

582. Strategies for Communication in Outdoor Recreation. (0-5) Cr. 2. Prereq: 451. Advanced skills, methods, and educational practices in program planning and in communicating values of the outdoor environment.

**Physical Education (P E)**
355. Kinesiology. (3-3) Cr. 4. F.S. Prereq: Zool 156, Phys 101 or 106 or 111. The study of anatomical and mechanical phenomena which underlie human motion. Includes the application of kinesiological concepts to a wide variety of physical education activities.


**390. Physical Education for the Developmentally Disabled.** (1-2) Cr. 2. F. Prereq: Psych 230. Etiology, incidence, and characteristics of the developmentally disabled, and resulting implications for physical education. Emphasis on adaptation of activities, methods, and program planning. Observation opportunities available.

**392. Physical Education for the Physically Disabled.** (1-2) Cr. 2. S. Prereq: Psych 230. Organization of an adapted physical education program. Study of specific disabling conditions in terms of etiology, description, and potential for movement and activity. Activities and specific exercises aimed at the rehabilitation of the individual.

455. Physiology of Exercise. (2-3) Cr. 3 F.S. Prereq: Zool 156. Physiological basis of human performance; effects of physical activity on body functions.

475. Physical Education Curriculum Design and Program Organization. (3-0) Cr. 3 F.S. Prereq: 375. Current and applied curriculum development (K-12) and to problems of organization and administration of instructional and extracurricular programs in physical education.

**Courses Primarily for Graduate Students, major or minor, open to qualified undergraduates**

505. Research Laboratory Techniques in Exercise Physiology. (2-0) Cr. 1. Prereq: 455 or equivalent course with basic laboratory experience. Application and use of laboratory research equipment in exercise physiology, including operation, calibration, and use in selected situations.

520. The Social Analysis of Sport. (3-0) Cr. 3. Prereq: 360. Soc 134 Sociological analysis of sport with emphasis on sociological theory, sports structure, and function in modern industrialized society; the systems of sport in regard to their role structure, formal organization, and professionalization and its differentiation among social class, age, and sex.

521. Sport Psychology. (3-0) Cr. 3 Prereq: 360, 3 courses in psychology. Aspects of psychology which form a basis for understanding and explaining behavior in a sport context. Variables underlying individual as well as group performance will be analyzed. A critical analysis of current research literature.

523. Sex Roles and Sport. (W S 523) (2-0) Cr. 2 Prereq: 360, 3 courses in sociology and/or psychology. Analysis of the influence of sport on male and female sex role development. Survey of literature related to sport and sex role socialization, stereotyping, and conflict. Discussion of future issues and alternative roles.

540. Administration of Physical Education and Sport. (3-0) Cr. 3. Prereq: 475 or 402. Theory and practice of administration in physical education and sport; development of concepts related to the process of administration, types of administrative behavior, tasks and responsibilities of the administrator; evaluation of effectiveness of administration.


560. Perceptual Motor Learning. (2-3) Cr. 3 Prereq: 370. Psych 333 or equivalent. Emphasis on theories of perceptual motor learning characteristics of the learner and the learning environment with implications for the classroom and further research.


570. (DL 395) Adapted Physical Education. (2-3) Cr. 3 Prereq: 375. Graduate study in conjunction with P E 395. Additional readings, term project, and special examination required. May not be taken by students who have previously earned credit in P E 390 or 382 or 386.

590. Special Topics. Cr. 1 to 3.

- A. Physical education
- B. Leisure studies

591. Supervised Field Experience. (0-2 to 6) Cr. 1 to 4. Prereq: 10 graduate credits in physical education and/or related areas. Supervised on-the-job field experience in special areas.

- A. Physical education
- B. Leisure studies

593. Workshops. Cr. 1 to 3.

- A. Physical education
- B. Leisure studies

**Courses for Graduate Students, major or minor.**

615. Seminar. (1-3-0) Cr. 1 to 3.

- A. Physical education
- B. Leisure studies


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**Physics**

Clayton A. Swenson, Chair of Department

**The Graduate Faculty**

**Members:** Anderson, Barnes, Beavers, Bowen, Carlson, Carr (Emeritus), Clem, Cook, Crawley, Danielson, Earls (Emeritus), Finnmore, Firestone, Fuchs, Grossman, Hammer, Harmon, Hill, Hodges, Jensen (Emeritus), Kernan, Kirkham (Emeritus), Klemm, Kliwer, Lamb, Lassila, Leacock, Legvold (Emeritus), Liu, Lynch, Parker, Peterson, Pursey, Rosenberg, Ross, Ruedenberg, Shelton, Spedding (Emeritus), Stanford, Stassis, Swenson, Vary, Weber, Williams, Willson, Wohl, Young, Zaffarano

**Associate Members:** Lewis, Nolan

The department offers work for the degree Master of Science and for the degree Doctor of Philosophy with majors in physics, astrophysics, high energy 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 or astronomy from other institutions who have qualitatively 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 30 credits of acceptable graduate work must be completed, not less than 21 of which must be in physics and astronomy and not less than 6 from the outside department or in areas different from the student’s major area. At least 15 of the credits in physics must be in courses at the 500 or 600 level exclusive of 595 and 699. Students choosing a degree with thesis may apply up to 8 credits of 699 but no credits of 595 toward the minimum 30 credits. Students choosing a degree without thesis should apply 1 credit per semester of 595, up to 2 credits, but may not apply any credits of 699 toward the minimum 30 credits.

Each candidate for the Doctor of Philosophy degree is required to teach one year of elementary physics. In addition to course work in the major area a candidate must take 12 minor credit hours outside this area, not less than 6 of which must be from other departments.

The Physics Department cooperates in the interdisciplinary minor in Technology and Social Change. (See Technology and Social Change.)

**Astronomy and Astrophysics (Astro)**

**Courses for Graduate Students, minor only**


344L. Astronomy Laboratory. (0-8) Cr. 3 F. Prereq: Credit or classification in 344. Observational techniques and experiments in optical astronomy.

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Courses Primarily for Graduate Students, major or minor, open to qualified undergraduates

510. Observational Astrophysics. (1-4) Cr. 3 Alt. F. 1981. Prereq: A105 or Math 180. Designed to prepare students for research in the use of astronomical telescopes, instruments, and coordinate systems.

512. Radio Astronomy and Astrophysics (E E 518) (3-0) Cr. 3 Alt. S. offered 1982. Prereq: 365 or E 313. Radio astronomy fundamentals; wave polarization and measurement; radio telescope receivers and antennas; wave propagation in plasma; synchrotron emission; continuum and line spectra; physical conditions in radio sources.

520. Galactic and Extragalactic Astronomy. (3-0) Cr. 3. S. Prereq: 345, Phys 322. The interstellar medium, galactic structure, dynamics of external galaxies, evolution and classification of galaxies, extragalactic radio sources, quasars, cosmological models.

525. Stellar Evolution and Nucleosynthesis. (3-0) Cr. 3 Alt. S. offered 1983. Prereq: 345, Phys 322. Solution of the equations of stellar structure, analytic approximations and theorems relating to equilibrium stellar models, survey of the results of numerical calculations of nuclear burning in massive stars, final phases of stellar evolution, evolution of close binaries.

530. Special Topics. Cr. var.


592. Special Topics. Cr. var.

593. Introductory Research Seminar. (1-1) Cr. 1 F. Discussion by research staff of the research areas, expectations and opportunities in the field. For graduate physics majors only.


596. Advanced Topics in Physics. (1-3) Cr. 1 to 3 each time taken. F.S. Topics on advanced topics and recent developments.

Physics (Phys)

Courses for Graduate Students, major or minor

600. Advanced Seminar. (1-0) Cr. 1 each time taken. F.S. Topics of current interest in astronomy and astrophysics.

605. Advanced Topics in Astronomy and Astrophysics. Cr. 1 to 3 each time taken. F.S. Topics in stellar interiors and evolution, stellar atmospheres, interstellar matter, cosmology, solar physics, atmospheric sciences, and recent developments.

699. Research

600. Optical Physics. (3-0) Cr. 3. S. Prereq: 322, 332 or 324. Physical optics: interference, diffraction, scattering, polarization, coherence, topics in quantum optics.

605. Modern Physics. (4-0) Cr. 4 F. Prereq: 322, Math 266 or 371. Modern and classical mechanics, electricity and magnetism, wave phenomena, quantum mechanics, Schrödinger equation, quantum numbers, wave-particle duality, Bohr's model of the atom.

680. Stellar Physics. (3-0) Cr. 3. S. Prereq: 322, Math 385. A systematic development of quantum mechanics, including differential and operator solutions of the Schrödinger equation and applications of the so-called wave mechanics in fields of current interest, such as nuclear physics, atomic physics, and the study of atomic spectra.


691. Quantum Physics. (3-0) Cr. 3 each. Prereq: 391. 480. Quantum mechanics, wave mechanics, quantum mechanics, applications of quantum mechanics, wave mechanics, and electromagnetic waves.

701. General Relativity. (3-0) Cr. 3. S. Prereq: 361 or Math 465. Tensor analysis and differential geometry developed and used to formulate Einstein field equations. Solutions due to Schwarzschild and Kerr. General relativity and cosmology.

703. High Energy Physics. (3-0) Cr. 3. S. Prereq: 361 or Math 465. Advanced topics in high energy physics, nuclear physics, solid state physics, and atmospheric physics. Topics in other areas offered periodically, depending upon current staff interests.

611, 612. Quantum Theory of Solids. (3-0) Cr. 3 each. Prereq: 611: 511, 592; 612: 611. Electronic band structure, phonons, X-ray, neutron, and electron scattering; dielectric response; Boltzmann equation.

624. Theory of Nuclear Reactions. (3-0) Cr. 3 Alt. F. offered 1982. Prereq: 592 and 524. Theories of nuclear reactions, including compound nucleus, direct reactions, and multiple scattering theory.

674. Applications of Group Theory to Physics: Solid State Physics. (3-0) Cr. 3 Alt. F. offered 1981. Prereq: 524. Theory of groups and group representations, point, space, and rotation groups; applications to molecular and crystal structures, crystal field and spin-orbit interactions, energy bands and phonon dispersion relations.

675. Applications of Group Theory to Physics: Nuclear and High Energy Physics. (3-0) Cr. 3 Alt. S. offered 1982. Prereq: 592. Theory of Lie groups, Lie algebras, and their representations, detailed exposition of the three-dimensional rotation group, Lorentz group, Poncaré group, and SU(3); survey of other Lie groups of physical importance, applications to nuclear and particle structure, angular correlation theory, helicity states, relativistic partial wave analysis, elementary particle properties.

681, 682. Quantum Mechanics. (3-0) Cr. 3 each. Alt. Yr. offered 1982-83. Prereq: 681: 592, 682: 681. Angular momentum theory, second quantization, many-particle theory, photons and light scattering, relativistic wave equations with emphasis on Dirac's equation, introduction to quantum electrodynamics

699. Research
Plant Pathology, Seed and Weed Sciences

Abraham H. Epstein, Chair of Department

The Graduate Faculty

Members: Browning, Burris, Dunleavy, Fawcett, Hill, Hodges, Isely, McGee, McNabb, Norton, Simons, Staniforth, Stewart, Tachibana, Tiffany, Vakili

Associate Members: Braun, Clark, Epstein, Foley, Martinson, Mullen, Nyvall

The department offers studies for the degrees of Master of Science and Doctor of Philosophy with a major in plant pathology, and minor work for students majoring in other departments. A Master of Science nonthesis option is available. A student majoring in plant pathology may specialize in seed science or weed science.

Students entering graduate programs in the department need a sound background in the physical, biological, and mathematical sciences as well as adequate preparation in English.

For the degree of Doctor of Philosophy, the requirement in foreign language or its alternative is established by the student's advisory committee.

Courses for Graduate Students, minor only


416. Forest Pest Management. (For 416, Ent 416, M 416) (2-3 or 3-3) Cr. 3 or 5. S. Prereq: 8 credits in biological sciences, including Bot 207. McNabb. 3-credit course: Nature of forest- and shade-tree pests; agents of deterioration of woodland products. Separate laboratory for students in resource management or forest products. 5-credit course: An additional lecture and arranged laboratory using integrated case studies and computer simulations in the evaluation and economic analysis of protection and pest management problems, physical agents of tree damage, weekend field trips. Fee for field trips.

418. Weed Control with Herbicides. (P: M 418) (2-0) Cr. 2. S. Prereq: 216, Bot 310 or 320. Staniforth. Principles and practices of modern weed control with emphasis on herbicide technology; herbicide selectivity, mode of action, crop phytotoxicity and the fate of herbicides in the environment; weed biology and ecology as related to the efficacy of herbicides.


Courses Primarily for Graduate Students, major or minor, open to qualified undergraduates


541. Epidemiology and Control of Plant Diseases. (3-0) Cr. 3. F. Prereq: 407 or 416, Agron 421 or For 501 or Hort 525. Browning. Environmental and genetic control of disease development; theories of managing resistance genes and cultural practices to maximize natural control processes.


590. Special Topics. Cr. 1 to 3 each time taken. Prereq: 10 credits in biological sciences, permission of instructor.

A. Plant Pathology

B. Seed Science

C. Weed Science


Courses for Graduate Students, major or minor


699. Seminar. Cr. 1. F.S.

A. Plant Pathology

B. Seed Science

C. Weed Science


A. Plant Pathology

B. Seed Science

C. Weed Science

Political Science

Victor A. Olorunsola, Chair of Department

The Graduate Faculty

Members: Boles, Hadwiger, Kihl, Olorunsola, Parks, Rasmussen, Schmidt, Talbot, Wiggins

Associate Members: Dorfman, Hutter, Lee, McCormick, Maney, Moses, Shelley, Wessel, Whitmer

The department offers work for the degree of 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.

The department also offers a Master of Public Administration. This is a professional degree in public administration. It is designed to provide interested students with the training necessary to operate within a public bureaucracy and organization. The M.P.A. degree requires 39 semester credit hours.

Brochures setting forth the detailed requirements for the degrees within each option, for the M.A.J.D. degree, and the M.P.A. degree may be obtained from the political science office.

A usual prerequisite for major graduate work in the department is the completion of at least 15 semester credits in political science. The Graduate Record Examination (for both aptitude and advanced examinations) is strongly recommended.

Each student entering the Master of Arts program in political science is expected to have completed one year of a foreign language (equivalent to eight semester 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’s recommended, but not required.

These requirements are only the basic minima. The student’s program of study committee will decide if additional work, in either language or statistics, is necessary.

The department also offers a Master of Arts program, with no language requirement and a choice of a thesis or a comprehensive examination, to those students who wish to prepare for, or are employed in, government service.

The department cooperates in the interdepartmental programs of Industrial Relations, Transportation Planning, and Technology and Social Change. (See Index.)

Courses for Graduate Students, minor only

410. Iowa Government and Politics. (3-0) Cr. 3. F. Prereq: 215. Wiggins. 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.

411. Public Policy and Local Government. (3-0) Cr. 3. Alt. S. Prereq: 310. Boles. Analysis of structure, administration, and legal basis of the county, township, and special districts, such as school and drainage districts. Evaluation of local governmental functions, such as education, welfare, highways, including problems of taxation and finance. Effects of population shifts on future of local governments.


422. International Law. (3-0) Cr. 3. S. Prereq: 215 or 251. Junior classification. Dorfman. 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.
Courses for Graduate Students, major or minor

610. Graduate Seminars. (3-0) Cr. 3 for each seminar. F.S. Prereq: 15 credits in political science.
A. American Political Institutions
B. Public Law
C. Political Theory and Methodology
D. Comparative Government
E. International Relations
F. Policy Process
G. Public Administration and Public Policy

Professional Studies in Education

J. Stanley Ahmann, Chair of Department

The Graduate Faculty


Associate Members: Abelison, Barnhart, Baum, Beard, Boyles, Canute, Deems, Downs, Duffelmeyer, Goering, Hart, Henney, Huba, Jones, Keller, Kelly, Lawrence, Littrell, McNally-Jarchow, Miller, Schloerke, Stow, Sweeney, Volker, Zbaracki

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 and extension education: educational administration; counselor education; higher education; historical, philosophical, and comparative studies in education; research and evaluation; curriculum and instructional media. The master’s degree is the highest degree awarded in the elementary education, learning disabilities, and physical education areas of specialization.

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, or graduate preparation in a discipline to be used as a teaching field in a community college or university, and adequate proof that the student ranks above average in scholastic ability and promise of professional competence.

The foreign language requirement, if any, for the Ph.D. degree will be determined by the student’s program of study committee. If no foreign language is required, the total program must consist of a minimum of 78 semester hours, at least 16 of which must be earned outside the area of specialization. Research tools such as statistics and research methods may not be included in the 16 hours. Should foreign language be included, the program of study committee may adjust the minimum program requirement downward but in no instance may the required credit be less than 72 semester hours. 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, Physical Education, and General Graduate Studies or to graduate-level course offerings within other departments.

For additional information students should communicate with the supervisory committee.

Adult and Extension Education (Ad Ed)

John P. Wilson, Acting Section Leader

Course for minor graduate credit only

469. Introduction to Adult and Extension Education. (3-0) Cr. 3. F.S. Prereq: 9 credits in education or related areas. An overview of adult and extension education: its development, organizations, objectives, programs, and procedures. Designed for prospective extension agents and other adult educators.

Courses Primarily for Graduate Students, major or minor, open to qualified undergraduates

536. Foundations of Adult Education. (3-0) Cr. 3. F.S. Prereq: 469. A study of the modern practice of adult education from the perspective of its history, philosophy, and literature.

537. Teaching in Adult Education. (4-0) Cr. 4. S.S. Prereq: 469 or 536. Instruction and learning, theory, methods and techniques. Development of approaches for teaching adults.

538. Community and Adult Education. (3-0) Cr. 3. S. S. Prereq: 536. Application and procedures adult educators utilize in the development of community based education programs. Community education concepts, community needs, resources, leadership, and services.

539. Program Development in Adult and Extension Education. (3-0) Cr. 3. F. S. S. Prereq: 536. Principles, models and evaluation of program planning processes.

590. Special Topics. Cr. 1 to 6. Prereq: 9 credits in adult and extension education.

591. Practicum/Internship. Cr. 1 to 6. Prereq: 9 credits graduate work in adult and extension education. Practicum or internship designed for work exposure in adult and extension education. Examples include continuing education centers, community colleges, extension offices, training divisions, etc.

593. Workshop. Cr. 1 to 3. Prereq: 536. Workshops designed to provide intensive, concentrated, and experience-oriented exposure to a special adult and extension education topic.

595. Colloquium in Adult and Extension Education. Cr. 1 to 3. Prereq: 6 credits in education. Offered when demand warrants.
A. Adult Basic Education
B. Adult Counseling
C. Educational Gerontology
D. Dynamics of Instructional Groups
E. International Adult Education
F. Adult Training in Life/Career Planning
G. Nontraditional Education
H. Philosophy of Adult Education
I. Training Skills
J. Administration of Adult Vocational Education

Courses for Graduate Students, major or minor

601. Theory Building in Adult Education. (3-0) Cr. 3. Prereq: 536, 537, 538. Examines theories and developing theory in adult education.

615. Seminar. (1-0) Cr. 1-3. F.S.S.S. Prereq: 10 credits in adult and extension education, permission of instructor. Group study and discussion on student and staff research in adult and extension education.

699. Research. Cr. arr. F.S.S.S. Prereq: 10 credits in adult and extension education, permission of instructor.

Counselor Education (Co Ed)

Gordon Hopper, Section Leader

Courses Primarily for Graduate Students, major or minor, open to qualified undergraduates

530. Human Interaction and Learning. (3-0) Cr. 3. F.S.S.S. Prereq: 8 credits undergraduate education, sociology, or psychology. An overview of research, theory, and conditions that facilitate behavioral change in individuals and within institutions. Classroom instruction and assignments are planned so students can relate their individual needs to professional role expectations.
Courses for Graduate Students, major or minor

534. Development, Management and Evaluation in Guidance. (2-0) Cr. 2. S. Prereq: Co Ed 530. Proactive involvement in defining, delivering, scheduling, and evaluating guidance programs in a school setting. Leadership styles, public relations, and identifying and working within the school and community power structure in relation to establishing and redeeming guidance service objectives. Methods of evaluating the impact of guidance services.


555. Use of Assessment Instruments in Counseling and Counseling. (2-0) Cr. 2. At. S. offered 1982. Prereq: Co Ed 530. Practicum experience can be arranged at urban rehabilitation centers, etc.

560. Theories of Counseling. (2-0) Cr. 2. F. S. Prereq: 530. Current approaches to counseling for facilitation of choice and/or behavioral change.

561. Counseling Techniques: Adolescent and Young Adult. (2-1) Cr. 2. F. S. Prereq: Concurrent enrollment in 530 or Co Ed 560. A theory of practice to be exposed through didactic and laboratory work with clients. The laboratory portion stresses skill building in listening and responding, identifying barriers to change and planning intervention.

565. Counseling Techniques: Preadolescents. (2-0) Cr. 2. F. Prereq: Credit or classification, Co Ed 560. Applied use of role-playing, fantasy, classroom groups, relaxaion, etc. in counseling for facilitation of choice and/or behavioral change.

570. Theories of Group Procedures. (2-0) Cr. 2. S. S. Prereq: Co Ed 560. Current group counseling approaches for facilitation of choice and/or behavioral change.

571. Laboratory Experience in a Counseling Group. (0-0) Cr. 1. F. S. Prereq: Students will be participants in a counseling group. Offered on a satisfactory-fail basis only.

580. Practicum in Counseling. (2-0) Cr. 4. F. S. Prereq: Co Ed 561 or 560. Practicum experience can be arranged at urban centers, detention centers, MDTA centers, vocational rehabilitation centers. Designated for students who desire counseling experience in a nonschool setting. Practicum experience can be arranged at urban centers, detention centers, MDTA centers, vocational rehabilitation centers. Designated for students who desire counseling experience in a nonschool setting.


582. Practicum in Elementary School Counseling. (2-8) Cr. 4. F. S. Prereq: Co Ed 565. Placement in an elementary school. Counseling students, consulting with teachers and parents and coordinating activities that enhance student development and growth both in the cognitive and affective domains.

590. Special Topics. Prereq: 10 graduate hours in counselor education.

A. Creative Component, Cr. 1-2
B. Independent Study, Cr. 1-2

593. Workshop in Counseling and Guidance. (3-0) Cr. 2. S. Prereq: 555. Practicum in Elementary School Counseling. Workshop is designed to give practicing school counselors an in-depth exposure to a counseling model with concurrent opportunity for application of the model.

Courses for Graduate Students, major or minor

610. Group Counseling Practicum. (2-2) Cr. 1. F. S. Prereq: Co Ed 580, or 581, or 582. Supervised experience facilitating and processing counseling groups.

611. Advanced Counseling Practicum. (2-8) Cr. 4. F. S. Prereq: Co Ed 580, or 581, or 582. An advanced practicum experience primarily designed for doctoral students. Practicum placement can be made in a variety of settings.

615. Seminar. (1-3) Cr. 1. F. S. Prereq: 10 hours in counselor education. Seminars are designed to meet the needs of practicing school counselors and doctoral students.

620. Supervision of Counseling Practicum. (1-6) Cr. 2. F. S. Prereq: Minimum of 6 practicum credits. Designed to give doctoral students the experience of supervising M.S. level practicum and leading a practicum seminar. Individual sessions with M.S. level practicum students for critique of taped counseling sessions and supervision of other practicum activities through planning, grand evaluating job descriptions, and on-observation.


Curriculum and Instructional Media (Curr)

Lynn W. Glass, Section Leader

Courses Primarily for Graduate Students, major or minor, open to qualified undergraduates

501. Principles and Practices of Educational Media. (3-0) Cr. 3. F. S. Prereq: 530. Professor: Volker, Simson. Organization of educational media centers in school and industrial settings. Analysis of types of hardware and software necessary to design, produce, present, and evaluate instruction with media. Application of research findings relative to media and learning. Preparation of a variety of teaching materials.

502. Producing Visual Media. Cr. 2-4. S. Prereq: Curr 501. Professor: Volker, Simson. Cognition and design of visual instructional media as applied to still photography, film production, video tape production, or instructional graphics. Laboratory work in production of these media and analysis of research on the design, production and utilization.


511. Teaching Assistant's Orientation Seminar. (1-1) Cr. 1. F. S. Prereq: Graduate classification. Professor: Volker, Simson. Survey of basic techniques of college teaching for graduate assistants with no background in teaching. Videotaped microteaching experiences emphasizing methods of lecturing, conducting discussion, questioning and reinforcement are included, as well as simple media production and classroom testing and evaluation.

512. Strategies for Classroom Teaching. (2-3) Cr. 3. F. S. Prereq: Graduate standing. Professor: Volker. Thoretical basis and practical experience in designing lesson presentation, and evaluation of a body of knowledge in a specific content area. Behavioral objectives, production of media, microteaching, and methods for handling large group, small group, and individualized instruction.

542. The Secondary School Curriculum. (2-0) Cr. 2. F. S. Prereq: Teacher certification. Dilts, Glass, McNally-Jarchow. Curricular and co-curricular programs of secondary schools; recent trends in goals, content organization, and organization for instruction; local community resources as curriculum content.

543. The Administration of School Personnel I. (3-0) Cr. 3. Alt. F. S. Prereq: 9 credits in education. Excludes the power of the labor management relationship. Selection and deployment of the teaching and administrative staff, personnel policies, assignment, staff development, and salary administration.

546. School Business Management. (2-0) Cr. 2. S. Prereq: 541. Hart. Fiscal administration at the district and building level; functions and duties of the business manager; maintenance and operations; insurance; debt service; purchasing; district energy management, and budgeting.
548. Educational Policy Making and Interpretation. (3-0) Cr. 3. S.S. Prereq: 541. Bovis, Engel. Functions of policy making in education; current issues in educational policy making at the local, state, and national levels, problems of implementing and interpreting policy to the community. Power structure in the community and its relationship to the educational process. Techniques and practices of public relations in the policy making and administrative functions of a school district.

549. Planning Public School Facilities. (3-0) Cr. 3. F. Prereq: 541. Hart. Assessment of facility needs; selection of an architect; educational specification; siting site and acquisition; schematic design and design development; contract documents and the bidding process; the construction phase, remodeling; and retrofitting for energy conservation.


567. The Administration of Elementary Schools. (3-0) Cr. 3. F. S. Prereq: 557. Holhl. Patterns of elementary school organization; educational leadership through supervision; curriculum development, and in-service education. Administering pupil and auxiliary services, staff and community relations.

577. The Administration of Secondary Schools. (3-0) Cr. 3. S.S. Prereq: 541. Manatt, Engel. Secondary school organization, schedule making, management of pupil organizations, evaluation of pupil growth. Evaluation of the total program, staff utilization, and leadership.

590. Special Topics. Cr. 1 to 4. Prereq: 9 credits in education.

591. Supervised Field Experience. Cr. 1 to 6. Prereq: 15 credits in educational area. Supervised on-the-job field experience in special areas.

593. Workshops. Cr. 1 to 4. Prereq: 9 credits in education.

Courses for Graduate Students, major or minor

615. Seminar. (1-3-0) Cr. 1 to 3.

641. Administrative Problems. (3-0) Cr. 3. S. Prereq: 541, 543. Engel. A case study approach to the resolution of problems in educational administration. Emphasis on decision-making, conflict resolution, and communication using actual situations.

643. The Administration of School Personnel II. (2-0) Cr. 2. F. Prereq: 543, Engel. All aspects of collective bargaining in the public sector. Selected topics such as affirmative action, legal aspects of personnel administration, evaluation of administration, and staff welfare.

644. Educational Finance. (3-0) Cr. 3. S. Prereq: 541, 543. Hart. State and local tax structure in support of public education; federal programs; assessment practices; disparities in wealth among school districts; suitability of the property tax as a revenue development; techniques of state aid in theoretical models of state aid formulas; practical application of the proportionate sharing formula and the foundation plan; and Iowa State aid formula.

678. Administrative Theory in Education. (3-0) Cr. 3. F. Prereq: Master's degree permission of instructor. Manatt. Historical background of current thinking in administration and organization; theoretical approaches to administration of functions and processes of administration as they apply to education.

679. Advanced Administrative Theory in Education. (2-0) Cr. 2. S. Prereq: 678. Manatt. Critical evaluation of the major research in systems analysis, operations research, and system models as they apply to the management of schools and colleges; staff development techniques and theories, models and cases of organization development.

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 Specialist degree 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 Index).

A formal class and a supervised practicum in the teaching of psychology is required of all doctoral degree candidates and strongly recommended for master's level students whose future plans may include teaching at the college level.

Courses for Graduate Students, minor only

3111 Laboratory in Brain and Behavior. (3-0) Cr. 2. S. Prereq: 230. Training in the design and/or interpretation of appropriate evaluation procedures and evaluation models. Discussion of relevant topics such as norm vs. criterion referencing, domain referenced tests, competency testing, grading practices, etc.

3150 Program Evaluation. (2-0) Cr. 2. F.S.S. Prereq: 550. Techniques of conducting an evaluation of instructional programs. A variety of evaluative models will be explored and the student will apply at least one such model to an on-going program.

560. Principles of Evaluation. (2-0) Cr. F.S.S. Prereq: 550. Training in the design and/or interpretation of appropriate evaluation procedures and evaluation models. Discussion of relevant topics such as norm vs. criterion referencing, domain referenced tests, competency testing, grading practices, etc.

561. Program Evaluation. (2-0) Cr. F.S.S. Prereq: 550. Techniques of conducting an evaluation of instructional programs. A variety of evaluative models will be explored and the student will apply at least one such model to an on-going program.

Courses for Graduate Students, major or minor

615. Seminar. (1-0) Cr. 1. Prereq: 3 credits in research and evaluation or permission of instructor. Group study and discussion on a wide variety of topics in research and evaluation.

654. Advanced Educational Research and Design. (3-0) Cr. F.S.S. Prereq: 553. Advanced research methodology and design of experiments. Problem selection, design, measurement, statistical analysis, and interpretation of data. Applicable for thesis or dissertation research.


Psychology

David C. Edwards, Chair of Department

The Graduate Faculty


Associate Members: Cresham, Hannum, Krulwitz

Courses for Graduate Students, major or minor, open to qualified undergraduates

550. Basic Educational Research with Statistical Application. (3-0) Cr. 3. F.S.S. Prereq: 9 credits in education, psychology, methodology, application of fundamental statistical concepts and basic procedures for analyzing educational data. Designed primarily for educators doing non-thesis work.

552. Beginning Educational Statistics and Research. (3-1) Cr. F.S.S. Prereq: 9 credits in education, and 550 or 3 credits in mathematics. Statistical concepts and procedures for analyzing educational data. Introduction to educational research design and descriptive statistics with educational computer applications.

553. Intermediate Educational Statistics. (3-1) Cr. 3. S.S. Prereq: 552. A continuation of statistical concepts and procedures for analyzing educational data. Inferential techniques with educational computer applications.

557. Computer Applications in Education. (3-0) Cr. 3. F.S.S. Prereq: 550 or 552. Use of computers in processing educational research data including experiences utilizing statistical packages such as SPSS and a general purpose language such as PCL. Data coding, data representation and conversion, files, computer organization, and job control language.

560. Principles of Evaluation. (2-0) Cr. 2. F.S.S. Prereq: 550. Training in the design and/or interpretation of appropriate evaluation procedures and evaluation models. Discussion of relevant topics such as norm vs. criterion referencing, domain referenced tests, competency testing, grading practices, etc.

561. Program Evaluation. (2-0) Cr. 2. F.S.S. Prereq: 550. Techniques of conducting an evaluation of instructional programs. A variety of evaluative models will be explored and the student will apply at least one such model to an on-going program.

Special Topics

3111 Laboratory in Brain and Behavior. (3-0) Cr. 2. S. Prereq: 331. Computer organization, and job control language.

3150 Program Evaluation. (2-0) Cr. 2. F.S.S. Prereq: 550. Techniques of conducting an evaluation of instructional programs. A variety of evaluative models will be explored and the student will apply at least one such model to an on-going program.

560. Principles of Evaluation. (2-0) Cr. F.S.S. Prereq: 550. Training in the design and/or interpretation of appropriate evaluation procedures and evaluation models. Discussion of relevant topics such as norm vs. criterion referencing, domain referenced tests, competency testing, grading practices, etc.

561. Program Evaluation. (2-0) Cr. F.S.S. Prereq: 550. Techniques of conducting an evaluation of instructional programs. A variety of evaluative models will be explored and the student will apply at least one such model to an on-going program.

Courses for Graduate Students, minor only

3111 Laboratory in Brain and Behavior. (3-0) Cr. 2. S. Prereq: 230. Training in the design and/or interpretation of appropriate evaluation procedures and evaluation models. Discussion of relevant topics such as norm vs. criterion referencing, domain referenced tests, competency testing, grading practices, etc.

3150 Program Evaluation. (2-0) Cr. 2. F.S.S. Prereq: 550. Techniques of conducting an evaluation of instructional programs. A variety of evaluative models will be explored and the student will apply at least one such model to an on-going program.

3150 Program Evaluation. (2-0) Cr. 2. F.S.S. Prereq: 550. Techniques of conducting an evaluation of instructional programs. A variety of evaluative models will be explored and the student will apply at least one such model to an on-going program.

560. Principles of Evaluation. (2-0) Cr. F.S.S. Prereq: 550. Training in the design and/or interpretation of appropriate evaluation procedures and evaluation models. Discussion of relevant topics such as norm vs. criterion referencing, domain referenced tests, competency testing, grading practices, etc.

561. Program Evaluation. (2-0) Cr. F.S.S. Prereq: 550. Techniques of conducting an evaluation of instructional programs. A variety of evaluative models will be explored and the student will apply at least one such model to an on-going program.

Courses for Graduate Students, major or minor

615. Seminar. (1-0) Cr. 1. Prereq: 3 credits in research and evaluation or permission of instructor. Group study and discussion on a wide variety of topics in research and evaluation.

654. Advanced Educational Research and Design. (3-0) Cr. 3. F.S.S. Prereq: 553. Advanced research methodology and design of experiments. Problem selection, design, measurement, statistical analysis, and interpretation of data. Applicable for thesis or dissertation research.


Courses for Graduate Students, major or minor, open to qualified undergraduates

550. Basic Educational Research with Statistical Application. (3-0) Cr. 3. F.S.S. Prereq: 9 credits in education, psychology, methodology, application of fundamental statistical concepts and basic procedures for analyzing educational data. Designed primarily for educators doing non-thesis work.

552. Beginning Educational Statistics and Research. (3-1) Cr. F.S.S. Prereq: 9 credits in education, and 550 or 3 credits in mathematics. Statistical concepts and procedures for analyzing educational data. Introduction to educational research design and descriptive statistics with educational computer applications.

553. Intermediate Educational Statistics. (3-1) Cr. 3. S.S. Prereq: 552. A continuation of statistical concepts and procedures for analyzing educational data. Inferential techniques with educational computer applications.

557. Computer Applications in Education. (3-0) Cr. 3. F.S.S. Prereq: 550 or 552. Use of computers in processing educational research data including experiences utilizing statistical packages such as SPSS and a general purpose language such as PCL. Data coding, data representation and conversion, files, computer organization, and job control language.

560. Principles of Evaluation. (2-0) Cr. 2. F.S.S. Prereq: 550. Training in the design and/or interpretation of appropriate evaluation procedures and evaluation models. Discussion of relevant topics such as norm vs. criterion referencing, domain referenced tests, competency testing, grading practices, etc.

561. Program Evaluation. (2-0) Cr. 2. F.S.S. Prereq: 550. Techniques of conducting an evaluation of instructional programs. A variety of evaluative models will be explored and the student will apply at least one such model to an on-going program.

560. Principles of Evaluation. (2-0) Cr. F.S.S. Prereq: 550. Training in the design and/or interpretation of appropriate evaluation procedures and evaluation models. Discussion of relevant topics such as norm vs. criterion referencing, domain referenced tests, competency testing, grading practices, etc.
Psychology, permission of instructor.

580. Current theories, methods, and research in advanced social psychology, including attraction, aggression, and helping behavior.

581. Advanced Social Psychology. (3-0) Cr. 3. S. Prereq: 440. Critical evaluation of current research, advanced methodologies, and professional problems in industrial psychology.

581. Advanced Organizational Psychology. (3-0) Cr. 3. S. Prereq: 440. Stat 402. Examination of organizational behavior research including motivation, job satisfaction, organizational climate, organizational effectiveness, and the environment. Attention is given to theoretical, methodological, and applied issues.

580. Advanced Personality Psychology. (3-0) Cr. 3. F. Prereq: 4 courses in psychology, including 360. Analysis of theories of personality, concepts, methods, and current research issues.

561. Psychopathology and Behavior Deviations. (3-0) Cr. 3. S. Prereq: 460. Critical review of theoretical perspectives and current research on the development and maintenance of the major forms of maladaptation including schizophrenia, anxiety, affective, drug use, personality, psychosexual, reactive, and childhood disorders.

562. Personality Assessment. (3-0) Cr. 3. S. Prereq: 360, 440. Stat 402. Principles, concepts, and methods of personality assessment. Though not a practicum course, exposure is given to a variety of objective, projective, and situational tests.

580. Advanced Social Psychology I: Psychological Perspectives. (3-0) Cr. 3. F SS. Prereq: 4 courses in psychology, including 280. Current theories, methods, and research in social psychology with an emphasis on individual processes such as attribution, attitude change, attraction, aggression, and helping behavior.


590. Special Topics. Cr. var. Prereq: 12 credits in psychology, permission of instructor. Guided reading on special topics or individual research projects.

A. Counseling
B. Industrial-Organizational
C. School Psychology
D. Individual Differences
E. Experimental
F. Educational
G. Physiological
H. Abnormal
J. Engineering
K. Developmental
L. Exceptional Children
M. Consumer
N. Social
O. Personality
P. Psychometrics

Courses for Graduate Students, major or minor

601. Historical and Systematic Psychology. (3-0) Cr. 3. F. Prereq: Second year graduate classification. Origins of psychology in philosophical, medical, and related thought. Development as an independent discipline in the nineteenth and twentieth centuries. Traditional and contemporary theoretical approaches to areas of experimental, academic, and applied psychology.

621. Psychological Counseling: Introduction to Theory, Process, and Techniques. (3-2) Cr. 4. F. Prereq: 4 courses in psychology including 440 and 460. Combined survey of theoretical issues and approaches with practical development of counseling skills and techniques. Didactic coverage of theoretical viewpoints at an introductory level. Laboratory based development of relationship skills and interviewing techniques using modeling, role playing, and case studies.

623. Vocational Behavior. (2-0) Cr. 2. F. Prereq: 3 courses in psychology. Theories, research, and issues in career development and choice, relationships to job satisfaction and performance, influences of sex roles, age, sociocultural factors on career behavior.

625. Group Counseling. (2-2) Cr. 3. S. Prereq: 621. Survey of theoretical approaches, research, techniques, issues, and ethics in group counseling. Concurrent participation in a group counseling experience.

627. Behavior Therapy. (3-0) Cr. 3. F. Prereq: 513. Research and theory underlying application of learning principles to techniques of behavior change. Introduction to methods of behavior analysis and techniques of behavior therapy.

628. Advanced Counseling Theory. (2-0) Cr. 2. S. Prereq: 524 or 562. Survey of counseling theories. Issues in counseling and research on counseling interventions.

633. Teaching of Psychology. (1-0) Cr. 1. F. Prereq: Enrollment in degree program in psychology. In-depth coverage of major theoretical positions, including comparative analysis. Coverage and evaluation of research on counseling interventions.


691. Practicum in Psychology. Cr. var. Prereq: Permission of Instructor. Supervised practice and experience in the following fields of specialization in applied psychology:

A. Counseling
B. Industrial-Organizational
C. School Psychology
D. Individual Differences
E. Teaching Preparation
F. Psychoeducational Assessment

692. Seminar in Psychology. (1-0 to 3) Cr. 1 to 3 each time offered when demand warrants.

A. Counseling
B. Industrial-Organizational
C. School Psychology
D. Individual Differences
E. Experimental
F. Educational
G. Physiological
H. Abnormal
I. Engineering
K. Developmental
L. Behavioral Consultation
M. Professional Issues and Ethics
N. Social
O. Personality
P. Psychometrics

699. Research

Sociology and Anthropology

Gerald E. Klonglan, Chair of Department

The Graduate Faculty


Associate Members: Aigner, Bruner, Harrod, Hoiberg, Hoyt, Harba, Huang, Johnson, Korschinger, Lee, Miller, Nowak, Rombough, Ryan, Wilcox, Winkepleck

Sociology

The department offers work for degrees in Master of Science and Doctor of Philosophy with majors in sociology and rural sociology and minor work for students majoring in other departments. For M.S. and Ph.D. departmental requirements, see "Program of Graduate Study for Degrees in Sociology and Rural Sociology," available from the department office. Some of the fields of possible concentration are community studies and development, complex organizations, crime and deviance, environmental sociology, family, gerontology, methodology, population/ecology, rural sociology, social change and development, social organization, social psychology, and sociological theory. Within the sociology major, students may specialize in anthropology at the master's level. The sociology department does not offer a nonthesis master's program.

Although the department stipulates no language requirement for either the degree Master of Science or the degree Doctor of Philosophy, specifying competence in one or more languages may be desirable in some instances.

The department participates in the interdepartmental programs of Gerontology, Industrial Relations, Technology and Social Change, Transportation Planning, and Water Resources (See Index).

Religious Studies

For description of courses, see Philosophy.

Secondary Education

See Professional Studies in Education for description of courses.

Courses for Graduate Students, minor only

400. History of Sociological Thought. (3-0) Cr. 3. Alt. F. offered 1981. Prereq: 130 or 134. Surveys the source and content of sociological thinking from ancient civilizations to roughly 1900.

401. Contemporary Sociological Theories. (3-0) Cr. 3. F S. Prereq: 130 or 134. Contemporary sociological theories and applied uses for research, understanding, and analyzing the social world.

405. Sociology of Language (Sociolinguistics). (3-0) Cr. Alt. F. offered 1985. Prereq: 130 or 134. Anth 221 or Eng 219. Analysis of language structure and linguistic behavior in various social contexts, language and technological change, language planning, linguistic behavior relative to social stratification, ethnic and racial groups, and reference groups, language in socialization and assimilation, language problems in social change.

410. Urban Sociology. (3-0) Cr. 3 or (3-1) Cr. 4. S. Prereq: 130 or 134. Growth, structure, and functions of the city, urban-social relations. Optional fourth credit contains guided research or other complementary study.

411. Societal Change and Development. (3-0) Cr. 3. F. Prereq: 130 or 134. Contemporary changes in rural and urban society with analysis of social institutions, social organization, and values. Theory 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. Prereq: 130 or 134. Processes of adoption and diffusion of innovations. Factors related to differential
521. Social Groups. 30 Cr. 3 Alt. S. offered 1982. Prereq: 305 or Psych 280. Examination of alternative theoretical models and methods of studying small groups.

522. Attitude and Attitude Change. 3(0) Cr. 3 Alt. S. offered 1983. Prereq: 305 or Psych 280. Analysis of theories of attitude and attitude change; current controversies between the theories examined, as well as supporting research on the theories.

523. Models of Community. 3(0) Cr. 3 Alt. S. offered 1984. Prereq: 6 credits in sociology. Examination of current controversies between the theories of community, analysis, social organization, organizational structure and processes, values, and evaluation.

546. Community Action. 3(0) Cr. 3 F.S. Prereq: 130 or 134. Community analysis of mobilization and organization of human and social systems for social action and group process. 

572. Social Work in Small Systems. 4(0) Cr. 4. F. Prereq: 261, credit or classification in 461. Issues and skills for planned change in planning and allocation policy arenas regarding social provision and social services. Human service organizations and policy units from the local to the national level examined with respect to issue identification, organization, and the impact of policy on the organization.

573. Models of Community. 3(0) Cr. 3 Alt. S. offered 1984. Prereq: 6 credits in sociology. Examination of current controversies between the theories of community, analysis, social organization, organizational structure and processes, values, and evaluation.

574. Contemporary Theories of Social Change. 3(0) Cr. 3 Alt. S. offered 1984. Prereq: 6 credits in sociology. Contemporary theories of social change, modernization and development are critically examined; methodological and theoretical issues identified; supporting research explored; and, the applicability of theoretical models, concepts, and strategies to current national and international needs evaluated.


577. Socialization. 3(0) Cr. 3 Alt. S., offered 1983. Prereq: 6 credits in sociology. Research and theory on the socialization of groups; socialization as an organizational process; socialization of new members; and socialization in contemporary society.


580. Sociology of Environmental Resources. 3(0) Cr. 3 Alt. S., offered 1983. Prereq: 6 credits in sociology. Theory and research on the contemporary environmental problems of mankind. Examination of current controversies between the theories of social change, modernization and development, and the impact of policy on the organization.


582. Social Psychology: A Sociological Perspective. 3(0) Cr. 3 F. Prereq: 305 or Psych 280. Examination of cognitive, social interaction, and social psychological approaches to social psychology. Observation, participant-observation, case studies, and interview techniques used. Life history, life sciences, content analysis, videographic practice.

583. Social Deviance. 3(0) Cr. 3 Alt. S., offered 1983. Prereq: 6 credits in sociology. Examination of deviant behavior. Analysis of small group, macro-level, and meso-level processes.

584. Social Psychology. 3(0) Cr. 3 Alt. S., offered 1983. Prereq: 6 credits in sociology. Examination of small group, macro-level, and meso-level processes.
Anthropology

The Department of Sociology and Anthropology offers the degree Master of Arts in Anthropology. Graduate courses are given in the areas of biological anthropology, archaeology, sociocultural anthropology, linguistic anthropology, history and theory, and methodology. Competence in one foreign language and in statistics is to be demonstrated. A thesis, generally based on original fieldwork, is required.

420. Archaeology of North America. (Am In 420) 3-0 Cr. 3. Alt. F., offered 1982. Prereq: 220, or 320, or 322. Prehistory and early history of North America as reconstructed from archaeological evidence, peoples of the New World, culture-historical sequences of major culture areas north of the Rio Grande, linkages of archaeological traditions which selected ethnohistorically known Native American groups.

426. Archaeology of Europe and the Near East. 3-0 Cr. 3. Alt. S., offered 1982. Prereq: 220 or 320. Ancient Europe from Paleolithic cultures to early literate societies as reconstructed from archaeological evidence: prehistoric background of Near Eastern and Mediterranean civilizations and their relationships to European peoples up to the time of the Roman empire.

428. Archaeological Laboratory Methods and Techniques. 3-0 Cr. 3. Alt. S., 1983. Prereq: 220; permission of instructor. Individual and/or group projects including laboratory processing and analysis of archaeological materials, experiments in technologies such as manufacture of stone tools or ceramics, writing a preliminary site report, design and preparation of a museum display.

429. Archaeological Field School. 8 to 10 SS. 8 to 10 weeks. Prereq. 220; permission of instructor. Summer field school for training in archaeological reconnaissance and excavation techniques; documentation and interpretation of archaeological evidence.

Courses Primarily for Graduate Students, major or minor, open to qualified undergraduates

500. Language and Culture. 3-0 Cr. 3. Alt. S., offered 1983. Prereq: 221. Structure and design of language; functional relationships between language, cognition, and culture; linguistic change; social and linguistic aspects of verbal behavior; language, word view, and cognitive style.

503. Primate Evolution. 3-0 Cr. 4. Alt. S., offered 1983. Prereq: 219 or Zool 206L. Comparative studies of the morphology and behavior of primates in neontological and paleontological perspective. Laboratory analysis of locomotor adaptations and variability in habitus and heritage; limb bones, muscles and fasciculi of early primates.

505. Urban Anthropology. 3-0 Cr. 3. Alt. F., offered 1982. Prereq: 6 credits in anthropology. Origins of urbanism; patterns of urban growth; migration to cities; effects of urbanization processes on the countryside.


520. Cultural Continuity and Change in the Prairie-Plains. (Am In 520) 3-0 Alt. F., offered 1981. Prereq: 322 or 429. Ecological adaptations, sociocultural changes, and continuities of traditions among Prairie and Plains Indian groups through time; impacts of Euro-American society and technology on Indians of the Great Plains; perspectives from ecology, archaeology, ethnology, history, and contemporary literary sources.

522. Seminar on American Indians. (Am in 522) 3-0 Cr. 3. Alt. F., offered 1982. Prereq: 322 or 332. Research and discussion of selected topics on contemporary and/or traditional Native American cultures.

529. Advanced Archaeological Methods. Cr. 1 to 5. F.S.S. May be taken for 8 to 10 credits in summer field school. Prereq: 429; permission of instructor. Archaeological field techniques and laboratory methods. Reconstruction of sociocultural activities from archaeological evidence.

530. Field Problems in the Ethnology of Contemporary Societies. Cr. 3 to 5. Alt. F., offered 1981. May be taken for 8 to 10 credits in summer field school. Prereq: 6 credits in anthropological field training experience in ethnography. Problems emphasizing field studies in the contemporary societies of the world.

533. Medical Anthropology. 3-0 Cr. 3. Alt. F., offered 1981. Prereq: 6 credits in anthropology. Study of human health in cultural and environmental context; comparison of health and disease patterns of western and non-western populations; use of epidemiological models in understanding illness and disease etiologies cross-culturally; interrelationship between diet and culture.

555. Seminar in Archaeology. 3-0 Cr. 3. Alt. S., offered 1982. Prereq: 320, or 334, or 420, or 426, or 429. Critical review and examination of traditional and contemporary methods and theories involved in the study of human behavior in the past.

560. Topical Studies in Anthropology. 3-0 Cr. 3 each time taken. Prereq: 6 credits in anthropology, permission of instructor. Graduate study in conjunction with a 300- or 400-level course in the topics listed below. May not be taken in conjunction with a 300- or 400-level course in which the student has previously earned credit.

A. Religion
B. Kinship
C. Psychological
D. Culture Change
E. Exekics
F. Archaeological
G. Economic
H. Visual Arts

561. Regional Studies in Anthropology. 3-0 Cr. 3 each time taken. Prereq: 6 credits in anthropology, permission of instructor. Graduate study in conjunction with a 300- or 400-level course in the areas listed below. May not be taken in conjunction with a 300- or 400-level course in which the student has previously earned credit.

A. North American Indian Ethnology
B. North American Archaeology
C. Latin American Ethnology
D. African Ethnology
E. African Archaeology
F. European Ethnology
G. Near Eastern Ethnology
H. European and Near Eastern Archaeology
I. Asian Ethnology
J. Australian Ethnology

590. Special Topics. Cr. 1 to 5. Prereq: 10 credits in anthropology; senior or graduate classification.

598. Advanced Topics in Anthropology. 3-0 Cr. 3 each.

599. Research.

Speech

Linda J. Busby, Acting Chair of Department

The Graduate Faculty

Members: Busby, Nelson, Underhill

Associate Members: Connolly, Dearin, Dreixel, Myers, Weaver, Wilson

The department offers courses for a graduate minor in speech as well as supporting work for other fields. Speech also participates in the interdepartmental program leading to a master's degree in General Graduate Studies.

Courses for Graduate Students, minor only

Communication Disorders (Sp)

371. Language Development. 3-0 Cr. 3. Prereq: 275. Development of language and speech acquisition in children; pragmatics of children's communication.


479. Practicum in Communication Disorders. 1 to 2 each time taken, maximum time 30. Prereq: 379, 376 or 477 or 480; grade point average of 3.0 in communication disorders courses, permission of instructor.


Interpersonal and Rhetorical Communication (Sp)

305. Semantics. 3-0 Cr. 3. F. S.S. Prereq: Engl 105. Nature of symbolic processes; determination of meaning; major approaches to linguistic study; impact of verbal habits in human affairs; relationships between language and thought in personal or social problems; accuracy in use of verbal symbols.

327. Persuasion. 3-0 Cr. 3. F. S.S. Prereq: 211 or 212. Examination of behavioral research in persuasion; scientific methods of evaluating persuasive communication; emphasis on application of experimental research: audience analysis, attention, perception, suggestion, logical, emotional and ethical proofs.

412. Speech Criticism. 3-0 Cr. 3. F. Prereq: 211 or 212, and 6 credits of Speech. Development of rhetorical theory and practice from Cicero to modern times. Application of principles of criticism to current public speaking practice.

Telecommunicative Arts (Sp)


434. Film Production and Structure. 3-0 Cr. 3. S. Prereq: J MC 319. Survey of film production with emphasis on relationship between writing and total production process. Exercises designed to develop skills in conceptualization, scripting, and continuity, and to relate filmic form and content to styles of direction, cinematography, lighting, sound, and editing.


Theatre (Sp)


466. History of Theatre II. (3-0) Cr. 3. S. Prereq: 465. Theatrical art from 1800 to present.

Courses Primarily for Graduate Students, Major or Minor, open to qualified undergraduates,*

504. Seminar. Cr. 1 to 3 each time taken. F.S.S. Prereq: 9 credits in speech. Topics may be included in the following areas:

A. Communication Disorders
B. Interpersonal and Rhetorical Communication
C. Telecommunicative Arts
1. Mass Media and Society
2. Women, Minorities, and Mass Media
3. Broadcast Survey Research
4. Film in Third World Culture
5. Women and Cinema
6. Theatre
7. Education
8. Speech Education

510. Classical Rhetoric. (3-0) Cr. 3. S. Prereq: 12 hours of speech. Greek and Roman tradition in rhetorical theory, practice, criticism, and pedagogy.

532. Radio Research and Programming. (2-2) Cr. 3 each time taken, maximum of 6 credits. S. Prereq: 330 or graduate classification. Research methods, program formats, directing, and management principles as related to radio.
533. Broadcast Program Production. (2-3) Cr. 1 to 3 each time taken. Maximum of 6 credits. S. Prereq: 433. Topics selected by students for half-hour programs. Research, planning, production, and direction in WOI studios.

536. Film Practicum. (1-6) Cr. 3 each. S. Prereq: 435. Application of production techniques in a complete 16 mm sound film project of professional quality. Students work together as crew members as the project evolves from concept to completion including research, scripting, filming, sound recording, editing, and the post-production functions.


555. Directing Practicum. (1-2) Cr. 2. S. Prereq: 455. Practical experience in directing the stage play.

556. Directing the Educational Theatre Program. (3-0) Cr. 3 S. Prereq: Graduation classification, 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.

590. Special Topics. Cr. 1 to 4 each time taken; maximum of 12 credits. S. Prereq: Permission of department chairman.

A. Communication Disorders
B. Interpersonal and Rhetorical Communication
C. Telecommunicative Arts
D. Theatre
E. Speech Education

599. Research.

Prerequisite to major graduate work is the completion of an undergraduate curriculum essentially equivalent to the curriculum in sciences and humanities at this institution including at least a year of calculus.

The degree Master of Science may be earned on either a thesis or nonthesis basis. The nonthesis option requires the completion of at least 34 credits of acceptable graduate work above satisfactory performance on a written examination.

The department encourages 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.

Courses for Graduate Students, minor only

401. Statistical Methods for Research Workers. (3-2) Cr. 4. S. F.S. Prereq: 101 or graduate classification. Statistical concepts and models; estimation; hypothesis tests with continuous and discrete data; simple and multiple regression; analysis of variance; introduction to data analysis of variance.

402. Statistical Design and the Analysis of Experiments. (2-2) Cr. 3 S. S. Prereq: 401. The role of statistics in research and the practical design of experiments. Experimental units, randomization, replication, blocking, subdividing and repeatedly measuring experimental units, factorial treatment designs and confounding; extensions of the analysis of variance to cover several crossed and nested classifications and models that include both classification and continuous factors.

403. Nonparametric Statistical Methods. (2-0) Cr. 2. Alt. F. Prereq: 228 or 401. Groeneveld. Analysis of data when dependent variable has ordinal or nominal properties; statistical inference for ranked data; rank correlation; efficiency of nonparametric procedures and robustness of comparable parametric procedures.

404. Statistics for the Social Sciences. (2-2) Cr. 3 F. Prereq: 401. Application of statistical methods to data in the social sciences; general linear regression models; covariance, miscellaneous estimation problems; path analysis, constructing composite measures; procedures with measurement error present.

405. Applied Econometric Statistics. (2-2) Cr. 3 S. Prereq: 404. Hoel. Methods of designing and analyzing survey investigations; simple random, stratified, multistage, and multiphase sampling designs; methods of estimation including ratio and regression; construction and use of confidence frames; organization of field work; data processing.

406. Statistical Methods in Quality Control. (2-0) Cr. 2 F. Prereq: 228 or 231 or 401. Single sampling plans for mean and attributes, sequential sampling, continuous sampling; control charts and process control.

407. Methods of Multivariate Analysis. (2-0) Cr. 2 F. Prereq: 402, knowledge of matrix algebra. Techniques of analyzing multivariate data including Hotelling's T^2; multivariate analysis of variance, principal components, cluster analysis.

421. Survey Sampling Techniques. (2-2) Cr. 3 S. Prereq: 228 or 404. Methods of designing and analyzing survey investigations; simple random, stratified, multistage, and multiphase sampling designs; methods of estimation including ratio and regression; construction and use of confidence frames; organization of field work; data processing.

431. Statistical Methods in Quality Control. (2-0) Cr. 2 F. Prereq: 228 or 231 or 401. Single sampling plans for mean and attributes, sequential sampling, continuous sampling; control charts and process control.

432. Applied Probability Models. (3-0) Cr. 3 F. Prereq: 231 or 341. Probabilistic models in engineering and the physical sciences; probability; Markov chains; Poisson and renewal processes; applications to queueing, scheduling, control, reliability, and other quantitative problems.


447. Statistical Theory for Research Workers. (3-0) Cr. 3 S. S. Prereq: 446 or Math 166. Prerequisite for graduate students not majoring in statistics. Emphasis on aspects of the theory underlying statistical methods. Probability, population distribution functions and their properties, sampling distributions, orthogonal linear functions, estimation, tests of hypotheses, regression, introduction to analysis of variance.


481. Computer Processing of Statistical Data. (3-0) Cr. 3 S. Prereq: 401. Com S 172 or knowledge of FORTRAN. The computer as a tool for statistical data analysis. Data structuring, file manipulation, and use of various data storage media. Algorithms, structure, and content of statistical packages. Advanced techniques in use of statistical software systems.

Courses Primarily for Graduate Students, major or minor, open to qualified undergraduates

500. Statistical Methods. (3-2) Cr. 4. F. Prereq: 101 and credit or classification in 542 and 579. Hinz, Koehler. Introduction to methods and analyzing data from experiments and surveys. Methods of analysis of variance including cross classifications, correlation, multiple regression; introduction to multiple comparisons; covariance; contingency-table analysis. Comparison of software utilized in data analyses.

501. Multivariate Statistical Methods. (3-0) Cr. 3 S. Prereq: 500 or 402, 447 or 542; knowledge of matrix algebra. Koehler. Elementary theory and techniques of analyzing multivariate data including Hotelling's T^2; multivariate analysis of variance, principal components, linear discrimination, canonical correlation. Analysis of categorical data including log-linear and logistic models.

511. Theory and Application of Linear Models. (3-0) Cr. 3 S. Prereq: 500 or 402 or 404 or 405; 542 or 447; a course in matrix algebra. Harville, KEMPTHORNE. Standard normal and classification models; matrix preliminaries, identifiability and estimability, intermediate theory of least squares and of best linear unbiased estimation; analysis of variance and covariance, replication, multiple comparisons, variance components, elementary randomization models and analysis.

512. Design of Experiments. (3-0) Cr. 3 F. Prereq: 541. Kempthorne, Harville. Basis for designing experiments and combinatorics with Galois fields, randomization analysis; factorial experiments, confounding, fractional replication; split-plot designs; incomplete block designs in general, balanced and partially balanced designs, associated mixed linear models, intra- and inter-block prediction strategies in factor screening, determination of optimum factor combinations; basic ideas of optimal design.

521. Theory of Sample Surveys I. (3-0) Cr. 3 S. Prereq: 401, 447 and 542. Goebel. Basic concepts and theory of designing sample surveys for finite populations; estimation of means, totals, proportions, variances, and covariances; frequently used designs such as simple random, stratified, systematic, cluster, and multistage sampling, ratio and regression methods of estimation.

522. Theory of Sample Surveys II. (3-0) Cr. 3 Alt. F. offered 1982. Prereq: 521. Goebel. Further topics in survey sampling, estimation, unbiased estimation, optimal stratification, multipurpose surveys, ratio and regression methods involving several auxiliary variables, double sampling, sampling over time, nonresponse errors and variance estimation for complex designs.


534. Ecological Statistics. (2-0) Cr. 2. Alt. S., offered 1983. Prereq: 542. Pollak. Models of population growth; growth of populations with two competing species; parasite-host and predator-prey relationships; elementary population genetics; selection, mutation, and migration in populations with one or more species; diversity; information theory.

535. Biological Statistics. (2-0) Cr. 2. Alt. SS., offered 1983. Prereq: 401 or 500. C. P. Cox. Direct and indirect biological assay; dose response curves; estimation from standard curves; parallel line and slope ratio assay; experimental designs for bioassay; multiple assays; quantal response assay analyses; radioimmunoassays; other statistical procedures according to student interests.

536, 537. Genetic Statistics. (Gen 536, 537) (2-0) Cr. 2 each. 536 Alt. F., offered 1981; 537 Alt. S., offered 1982. Prereq: 402, 448; Gen 320 or 330 or 460, permission of instructor. Pollak. Probability applied to genetic systems; random mating; selection and mutation; theory of inbreeding; some effects of finite population size; models for quantitative inheritance; partition of genotypic variance; covariances among relatives with random mating and selection; experimental designs for evaluating parameters; phenotypic selection for quantitative traits.


539. Game Theory. (Econ 539) (E 539) (3-0) Cr. 3. F. Prereq: 231 or 342 or 432 or 447. H. T. David. Zero-sum and two-person games; games of timing; relation to mathematical programming; non-cooperative and cooperative n-person games.

540. Operations Research Methods and Economic Analysis. (3-0) Cr. 3. S. Prereq: 539 or E 451 or Econ 537. Sposito. Methods and applications of selected techniques of modern mathematics, including linear, convex and quadratic programming. Applications in economics and operations research.


544. Bayesian Decision Theory. (3-0) Cr. 3. Alt SS. offered 1983. T. H. David. Prereq: 543. Meeden. Introduction to decision theory; risk sets; admissible strategies; randomized strategies; complete classes; Bayes and minimax strategies; examples of Bayes strategies; comparison of Bayesian and classical theories; exchangeability; estimation of the multivariate normal mean.


579. Introduction to Computer Hardware and Software Systems for Computing. (1-0) Cr. 1. F. Prereq: Graduate classification in statistics or consent of instructor. Kennedy. Designed to introduce students to the languages and conventions required for the use of the leading software systems in statistical computing. Both batch and interactive modes of usage are considered.


areas discussed include probability function approximation, simulation, and linear and nonlinear least squares methods.


Courses for Graduate Students, major or minor


642. Measure Theory and Probability. (3-0) Cr. 3. S. Prereq: 542; Math 514. Athreya, Issacson. Probability measure and distribution functions, random variables, characteristic functions; laws of large numbers; asymptotic distributions; matching asymptotic and non-asymptotic inferences of random variables, probability limit theorems, characteristic functions, convergence of a sequence of a random variable and a sequence of distribution functions; asymptotic distributions of sample quantities, U-statistics, rank tests, chi-square and other goodness of fit tests, Chernoff-Savage theorem, consistency, efficiency of tests.


684. Seminar on Theory of Statistics and Social Change. (3-0) Cr. 3. F. Prereq: 543. R. W. Wolansky. Designed to introduce students to the languages and conventions required for the use of the leading software systems in statistical computing. Both batch and interactive modes of usage are considered.

680. Advanced Statistical Computing. (3-0) Cr. 3. S. Prereq: 580. Kennedy. Selected methods and algorithms in the areas of unconstrained and constrained nonlinear function optimization, robust estimation, and classical multivariate analysis. Emphasis on the most recent advances in these and other areas supported by statistical computing.

699. Research.

Technology and Social Change

(Intermediate or Minor)


Students choosing to declare a minor in technology and social change will pursue a degree program in the major department. A member of the supervisory committee of the interdepartmental program will guide the student's program of study. This member should be a member of the graduate faculty and should be chosen by the student in consultation with the dean of the Graduate College.

The committee guiding the program of study of a student declaring a minor in technology and social change will select a group of courses from the list given below. For the master of science degree, this group should be at least 10 credit hours and for the doctor of philosophy degree the minimum requirement is 15 hours. Of this requirement, 4 hours must be chosen from courses in technology and social change acceptable for graduate credit.

The group of courses selected by the student's committee to form a minor in technology and social change must be chosen from outside the major area of study. They should be designed to broaden the scope of the student's training to include the humanities, the social sciences, and technology. The program for the declared minor will be approved by the technology and social change supervisory committee.
A minor in technology and social change should be selected from the following suggested courses:

- Aerospace Engineering: 350, 481, 486, 571, 575.

Agronomy: All courses appearing in graduate catalog are acceptable.

Animal Science: All courses appearing in graduate catalog are acceptable.

Anthropology: 533, 560D, 560E, 560G.


Chemistry: 331, 332, 426, 599.


Computer Engineering: 430, 440.

Computer Science: 375, 441.


Electrical Engineering: 450, 451, 474, 476.

English: 495, 534.


Food and Nutrition: 305, 319, 410, 413, 414.

Geography: 495.

Geology: 484.


Industrial Education: 502, 554, 615, 644, 652, 657.


Journalism and Mass Communication: 425, 515, 545, 590G, 590I, 590K.

Materials Science and Engineering: All courses appearing in graduate catalog are acceptable.

Meteorology: 406, 531.

Nuclear Engineering: 401, 484, 541, 654.

Philosophy: 380, 431, 480.


Political Science: 443, 444, 447, 448, 481, 543, 547, 549, 578.


Courses Primarily for Graduate Students, major or minor, open to qualified undergraduates.

541. Technology and Social Change in Foreign Cultures. (U St 541) (3-0) Cr. 3. F. Prereq: Senior or graduate classification. An interdisciplinary study of technology and the effects of technological change within economically developed countries. Analysis of the role of science and technology in development; implications and consequences of technology transfer; issues and constraints involved in choosing an appropriate technology.

542. World Food Issues. (U St 542) (3-0) Cr. 3. S. Prereq: 541 or graduate classification. An interdisciplinary study of societal, human and technological aspects of the world food situation. The study examines four issues: the present world food situation; the challenge of meeting future food requirements; constraints to growth and change, and professional, scientific, and technical strategies for development.

590F. Special Topics: Technology and Social Change. (U St 590F) Cr. var. F.S.S. Prereq: 541. Individual study on topics involving technology and social change in foreign cultures.

**Courses for Graduate Students, minor only**

640. Seminar in Technology and Social Change. (U St 640) Cr. 1-3 each time elected. S.S. Prereq: 541. Consideration of problems and issues arising from the effects of technological change in foreign cultures. Issues and problems vary each time offered.

**Telecommunicative Arts**

For description of courses, see Speech.

**Textiles and Clothing**

Agatha L. Huepenbecker, Head of Department

The Graduate Faculty

Members: Huepenbecker, Winakor

Associate Members: Farrell, Kim, Kundel

The department offers the degree Master of Science with a major in textiles and clothing, and a minor to students taking major work in other departments. The department participates in the interdisciplinary minor programs of Gerontology and Technology and Social Change (see index).

Prerequisite to major graduate work is the completion of selected courses in art and design, the humanities, physical and social sciences, and textiles and clothing. The specific prerequisites will depend upon the nature of the work the student wishes to pursue. A thesis is required.

**Courses for Graduate Students, minor only**

354. History of Costumes I. (3-0) Cr. 3. F.S., alt. SS. Prereq: 1983. History 201 or Art 280. Clothing styles of men, women, and children in western civilization from prehistoric times to present; factors associated with origin, adoption, and abandonment of styles.


464. Family Clothing Consumption. (3-0) Cr. 3. F.S., alt. SS. Prereq: 1982. Family Economics 201, major classification. Theories of clothing consumption; factors affecting family expenditures for clothing and household textiles; study of standard budgets.


468. Clothing for Special Needs. (3-0) Cr. 3. F. Prereq: 222 or 222, 165 or F.E. 380. Analysis of clothing problems as related to physical, social, and psychological well-being of people with special needs. Selection and design of functional clothing to meet specific requirements of children, the elderly, or individuals who may be physically or mentally handicapped.

**Courses Primarily for Graduate Students, major or minor, open to qualified undergraduates.**

500. Short Course. Cr. arr. SS.

A. Textiles

B. History of Textiles

C. Clothing Construction and Patternmaking

D. Fashion Design

E. History of Costume

F. Sociological and Psychological Aspects of Clothing and Textiles

G. Economic Aspects of Clothing and Textiles

**504. Textile Science.** (3-0) Cr. 3. S. Prereq: 204. Scientific principles and theories involved in fiber formation, fiber and fabric structures, color, and finishes; analysis of fabric geometry and deformation.


525. Advanced Patternmaking. (1-5) Cr. 3. S. Prereq: 345. 6 credits in patternmaking. Use of flat pattern drawings and draping techniques for more intricate designs of sleeves, bodices, dresses. Methods of drafting basic pattern blocks and pattern grading procedures. Patternmaking for tailored coat or jacket; for men's wear and children's wear.

545. Advanced Costume Design. (2-0) Cr. 2 S. S. Prereq: 2 credits from 345, Phil 340, Psychology 312. Analysis of costume in the light of theories formulated by writers on aesthetics, art history, costume history, and perception.

554. History of Costume II. (2-0) Cr. 2. F. Prereq: 354. Study of garments in the historic collection and their relationship to other sources of information; research techniques; individual study of selected periods.

555. History of Textiles II. (2-0) Cr. 2. S. Prereq: 355. Technical aspects of fabric structure and applied textile design within and across cultures; evolution of classic and individual textile motifs; research techniques, individual topics.


590. Special Topics. Prereq: Permission of department head and instructor(s) concerned. Cr. arr. Textiles

B. History of Textiles

C. Clothing Construction and Patternmaking

D. Fashion Design

E. History of Costume

F. Sociological and Psychological Aspects of Clothing and Textiles

G. Economic Aspects of Clothing and Textiles

**Courses for Graduate Students, major or minor**

610. Seminar. Cr. 1 S.

656. Asian Costume and Textiles. (2-0) Cr. Alt. I. S. Prereq: 1985. Prereq: 555. Asian history or Asian art history. Group and individual studies of traditional costume and textiles of selected countries. Includes China, Japan, Korea, Southeast Asia, India, Indonesia and selected Middle Eastern countries. Topics may vary with semester of offering.

667. Ethnic or Regional Costume and Textiles. (2-0) Cr. Alt. I. S. Prereq: 1985. Prereq: 555. Group and individual studies of traditional costumes and textiles of selected folk cultures. Includes cultures of Europe, the Americas, Africa, and Oceania. Topics may vary with semester of offering.

699. Research.
Transportation Planning
(Interdepartmental Major)

Robert L. Carstens, Chair, Supervisory Committee


Work is offered for degree Master of Science in transportation planning under a cooperative arrangement with various administrative departments including Civil Engineering, Community and Regional Planning, Economics, and the School of Business Administration, Industrial Engineering, Political Science, and Sociology. Opportunities are afforded for research in such areas as modeling and performance of transportation systems, techniques for urban and regional transportation system planning, environmental and social policy analysis of transportation systems, transportation policy analysis, analysis of transportation technologies, commodity distribution, public administration of the transportation planning process, regional development and transportation system interrelationships, transportation economics and finance, and planning for logistics management.

Students majoring in transportation planning will choose a major professor from the graduate faculty membership of the cooperating departments and will develop a program of study under the guidance of a committee nominated by the administrative department head, approved by the departmental transportation planning supervisory committee representative, and appointed by the dean of the Graduate College. For administrative purposes, students will be in the departments of their major professors. A student must complete at least 30 credit hours of acceptable work. At least 20 credits for the thesis option and 24 credits for the non-thesis option shall be selected from a list of courses approved for inclusion in a program in transportation planning. The foreign language requirement, if any, is established on an individual basis by the student's program of study committee.

Courses Primarily for Graduate Students, major only

690. Advanced Topics, Cr. 1 to 2. Creative component for non-thesis Master of Science degree.

691. Seminar in Transportation Planning, (1-0) Cr. 1 each time taken. F.S.

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, 290, 301, 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 Students, minor only


425. Environment and Society, (Env S 425) (3-0) Cr. 3. SS. Prereq: 10 hours in social of natural sciences. An in-depth analysis of natural and human-modified ecosystems with attention on energy, resources, food, and population as they relate to society and the quality of human environments.

Courses Primarily for Graduate Students, open to qualified undergraduates

541. Technology and Social Change in Foreign Cultures, (TSC 541) (3-0) Cr. 3. F. Prereq: Senior or graduate classification. An interdisciplinatory study of technology and the effects of technological change within economically less developed countries. Analysis of role of science and technology in development, implications and consequences of technological transfer, issues and constraints involved in choosing an appropriate technology.

542. World Food Issues, (TSC 542) (3-0) Cr. 3 S. Prereq: 541 or graduate classification. An interdisciplinary study of societal, human and technological aspects of the world food situation. The study examines four issues: the present world food situation; the challenge of meeting future food requirements; constraints to growth and change, and professional, scientific, and technical strategies for development.

590. Special Topics. Independent study on topics of an interdisciplinary nature. Intended primarily for graduate students.

F. Technology and Social Change, (TSC 590F)

Course for Graduate Students, minor only


Veterinary Anatomy

J. Carithers, Chair, Department

The Graduate Faculty

Members: Bai, Cholvin, Christensen, Dellmann, Ghoshal, Uehnura

Associate Members: Adams, Carithers, Jacobson, Magilton (Emeritus)

The department offers work for the degrees Master of Science and Doctor of Philosophy with a major in veterinary anatomy, and minor work for students majoring in other departments. Cooperative programs between Veterinary Anatomy and the Biomedical Engineering Program are provided jointly under sponsorship by the colleges of Engineering and Veterinary Medicine. See Biomedical Engineering for requirements. The department also participates in the interdepartmental program in Molecular, Cellular and Developmental Biology.

Fundamental knowledge of anatomy, biochemistry, chemistry, mathematics, physiology, and zoology is considered prerequisite for major study in the department.

Foreign language requirements may be established by the student's graduate advisory committee.

Courses Primarily for Graduate Students, major or minor, open to qualified undergraduates

509. Systematic Anatomy, (1-3 or 2-6) Cr. 2 or 4. SS. Prereq: One year of college biology, permission of instructor. For non-anatomy majors.

A. Ruminant Anatomy, Cr. 4.

B. Nonruminant Anatomy, Cr. 4.

C. Avian Anatomy, Cr. 2.

511. Neuroanatomy, (2-4) Cr. 4 Alt. F., offered 1982. Prereq: 10 credits in biological science, permission of the instructor. Gross and microscopic anatomy of the central nervous system including the organs of special sense.


520. Structure and Fine Structure of Animal Tissues and Organs, (3-6) Cr. 6. Alt. SS. offered 1982. Prereq: 10 credits in biological science, permission of the instructor. Study of the morphology of cells, tissues, and organs of domestic animals at the light and electron microscopic level.

521. Advanced Gross Anatomy, (2-9) Cr. 5 S. Prereq: Bachelor's degree in a biological science and permission of instructor. Systematic and topographic study and dissection of the horse, ruminant, and pig.

590. Special Topics. Cr. 1-5.

A. Gross Anatomy

B. Microscopic Anatomy

C. Developmental Anatomy

D. Neuroanatomy

Courses for Graduate Students, major or minor

690. Advanced Topics, Cr. 1-3.

A. Gross Anatomy

B. Microscopic Anatomy

C. Developmental Anatomy

D. Neuroanatomy

698. Seminar, Cr. 1.

699. Research.

A. Gross Anatomy

B. Microscopic Anatomy

C. Developmental Anatomy

D. Neuroanatomy
Veterinary Clinical Sciences

Wallace M. Wass, Head of Department
The Graduate Faculty

Members: Emmerson (Emeritus), Pearson, Wass
Associate Members: Carithers, Evans, Grieer, Hill, Lundvall

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 theriogenology. 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 program of study committee.

Prerequisite to major graduate work is graduation from an approved college of veterinary medicine.

Course for Graduate Students, minor only
443. Large Animal Orthopedics. (2-0) Cr. 2. S. Prereq: Permission of instructor. Third-year classification in veterinary medicine. Orthopedic diseases of large domestic animals.

Courses Primarily for Graduate Students, major or minor, open to qualified undergraduates
590. Special Topics. Cr. 1 to 3. Prereq: Permission of instructor. A. Medicine B. Surgery C. Theriogenology D. Radiology E. Anesthesiology
604. Seminar. Cr. 1. F.S.S.


Veterinary Microbiology and Preventive Medicine

T. T. Kramer, Chair of Department
The Graduate Faculty

Members: Beran, Gough, Harris, Hofstad, Kaeberle, Kramer, Mengeling, Packer, Piir, Reed, Ross, Switzer, Thoen, VanDerMaaten, Woodc
Associate Members: Abou-Gabal, Hill, Platt

The department offers opportunities for the degree Master of Science with majors in veterinary microbiology and veterinary preventive medicine. The degree Doctor of Philosophy with major in veterinary microbiology can also be earned. Courses are also offered to students doing major work in other departments.

Candidates for departmental majors must possess the D.V.M. degree or an undergraduate degree in biomedical sciences with emphasis in medical microbiology.

The department strongly recommends that applicants take the Graduate Record Examination and will use GRE scores as an important element in the selection of graduate students. The program of study for the Ph.D. requires students to take a foreign language requirement or a significant cultural component in a collateral field of study. The foreign language option can be satisfied by one year of college level courses in a foreign language (grade A or B) or a passing score on the ETS graduate student foreign language examination, or a test of scientific reading competence, administered by the department. The alternative cultural component may be in the general areas of language and communication, philosophy and the scientific method, logic, history of science and culture, human values, etc. The foreign language or cultural component requirement will be specifically determined by the student's program of study committee, with approval of the chair of department. For students whose native language is not English, the ability to communicate adequately (as certified by the Department of English) will be required during the first year of study.

The department also participates in the interdepartmental programs of Immunobiology and Molecular, Cellular and Developmental Biology (See Index).

Courses Primarily for Graduate Students, major or minor, open to qualified undergraduates
520. Medical Immunology I. (Blact. 520) (Imbio 520). (2-0) Cr. 2. F. Prereq: 381 or Micro 300. Kaeberle. The immune response, antigens, antibodies, antigen-antibody interactions and other effector mechanisms of resistance to disease.

520L. Medical Immunology Laboratory. (Imbio 520L) (0-6) Cr. 2. F. Prereq: Credit or classification in 520. Kaeberle. Principles of serology and detection of immunoreactivity as applied to diagnosis of disease and research in immunology.
524. Veterinary Medical Mycology. (Micro. 524) (2-6) Cr. 4. Prereq: 382 or Bot 596; permission of instructor. Gatal. Fungi pathogenic for animals and the diseases with which they are associated. Methods of isolation and identification.
529. Medical Immunology II. (Imbio 529) (4-0) Cr. 4. S. Prereq: 520; 6 credits in biochemistry, permission of instructor. Kaeberle. Role of immunologic mechanisms in health and disease. The immunologic system, the immune response, biochemical and immunologic factors regulating immunologic processes.

999. Research.

Veterinary Pathology

John P. Kluge, Chair of Department
The Graduate Faculty

Members: Glock, Greve, Jeska, Kluge, O'Toole, Ramsey (Emeritus), Zimmermann
Associate Members: Barnes, Carson, Cassidy, Cheville, Fiatt, D. L. Graham, Hagemosser, Kemp, Lloyd, Moon, Richter, M. G. I. Riley, Seaton, Stahr

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 or veterinary toxicology.

Prerequisite to major graduate work is the completion of an undergraduate curriculum leading to the degree Doctor of Veterinary Medicine. This requirement may be waived for those individuals wishing to specialize in toxicology or parasitology with the approval of the major professor and the chairman of the department.

88
The degree Master of Science with thesis requires the completion of a minimum of 30 graduate credits. It is possible to study for the degree Master of Science on a nonthesis basis. This option requires the completion of a minimum of 40 graduate credits, of which at least 10 must be earned in course work outside the department.

The foreign language requirement will be decided by the student's program of study committee, with the approval of the chairman of the department. For students whose native language is not English, the ability to communicate in English (as certified by the Department of English) will be required.

Minor work is recommended in other departments of the College of Veterinary Medicine or departments or programs in other colleges.

The department also participates in the interdepartmental program of Immunobiology. (See Index.)

Courses Primarily for Graduate Students, major or minor, open to qualified undergraduates.

551. (371 DL) General and Systematic Pathology. (4-3) Cr. S. F. Prereq: V An 301, 302; or Zool 322. Graduate study in conjunction with 371. Open only to students who do not have, or are not pursuing, the D.V.M. degree. Basic pathology with emphasis on disease in animals.

554. (426 DL) Veterinary Toxicology. (3-0) Cr. S. Prereq: 371. Graduate study in conjunction with 426. Disease processes and effects by toxicants differential diagnostic and therapeutic procedures.

556. Methods in Toxicology. (2-0) Cr. F. Prereq: 10 credits in biology, permission of instructor. Application and interpretation of specific toxicity tests for the determination of harmful effects of poisonous substances.

557. (376 DL) Veterinary Parasitology. (5-3) Cr. F. Prereq: 371 or 551. Graduate study offered in conjunction with 376. Open only to students who do not have, or are not pursuing, the D.V.M. degree. Parasitisms of veterinary importance, including the disease process and principles of control.


560. Special Topics. Cr. 1 to 3. F.S.S. Prereq: Permission of instructor.
A. Veterinary Pathology
B. Veterinary Parasitology
C. Veterinary Toxicology
D. Radiobiology

Courses for Graduate students, major or minor.

604. Histopathology Seminar. Cr. 1. F.S.S.

605. Topics Seminar. Cr. 1. F.


620. Toxicology of Heavy Metals and Trace Elements. (2-0) Cr. S. Prereq: offered 1982. Prereq: 554, permission of instructor. Advanced study of heavy metal pollutants and trace elements: their effects on, effects in, and effects on wildlife, man, and man.

634. Biotoxins. (3-0) Cr. F. Prereq: offered 1982. Prereq: 554, permission of instructor. Natural toxic background in the area of toxicology, presents from management practices, pesticides of biological origin, and venoms.

644. Feed Additives Toxicology. (2-0) Cr. S. Prereq: offered 1983. Prereq: 554, permission of instructor. Toxicology effects of feed additives and natural ingredients resulting from mismanagement or accident, federal regulations.

645. Analytical Chemical Toxicology. (1-3) Cr. 2. F. Prereq: Chem 211, 322, permission of instructor. Analysis and identification of toxicants residues in animal tissues, feeds, water, soil, and other environmental samples.

651. Advanced Post Mortem Techniques. (0-0 to 0) Cr. 1 to 3. F.S.S. Prereq: 376, 422. Staff. Necropsy techniques of animals with emphasis on gross and microscopic lesions and diagnosis.


678. Laboratory Animal Medicine. (V C 678). See Veterinary Clinical Sciences.

699. Research.
A. Veterinary Pathology
B. Veterinary Parasitology
C. Toxicology

Veterinary Physiology and Pharmacology

Donald C. Dyer, Chair of Department

The Graduate Faculty


Associate Members: Crump, Draper, Greer, Hsu, Martin

The department offers work for the degrees Master of Science and Doctor of Philosophy with majors in veterinary physiology or in veterinary pharmacology as a specialization, and minor work for students majoring in other departments.

Cooperative programs between Veterinary Physiology and Pharmacology and the Biomedical Engineering Program are provided jointly under sponsorship by the colleges of Engineering and Veterinary Medicine. See Biomedical Engineering. The department also participates in the interdepartmental program in Molecular, Cellular and Developmental Biology.

Fundamental knowledge of anatomy, biochemistry, chemistry, mathematics, physiology, and zoology is considered prerequisite for major study in the department.

Foreign language requirements may be established by the student’s graduate advisory committee.

Courses for Graduate Students, major or minor

360. General Pharmacology. (4-0) Cr. F. Prereq: 551 or 552. General principles, drug disposition, drugs acting on the nervous, cardiovascular, renal, gastrointestinal, and endocrine systems, antimicrobials and antineoplastics.

Courses Primarily for Graduate Students, major or minor


531. Physiology and Pharmacology of Synaptic Transmitter. (2-0) Cr. S. Prereq: offered 1982. Prereq: 551, permission of instructor. Randic and VarMeter. Anatomical distribution, actions, biochemical aspects of synthesis and degradation, release of possible transmitter substances in mammalian central nervous system. Several amino acids, acetycholine, catecholamines, 5-hydroxytryptamine, and some peptides of interest in neurobiology. Various drugs will be introduced where their action is related to the subject under discussion.

533. Physiology and Endocrinology of Animal Reproduction. (An S 533) (3-0) Cr. S. Prereq: General Pharmacology. Course development: structure and function of the reproductive system. Physiologic and endocrine aspects include puberty, gametogenesis, estrous cycle, pregnancy, parturition, and the interaction of environment, thyroid and adrenal function, and nutrition with these processes.

551, 552. Advanced Vertebrate Physiology. (B M E 551, 552) (Zool 551, 552) (4-3) Cr. 5 each. 551 F., 552 S. Prereq: B M E 509 or Zool 320 and 455, 455L, credit or classification in B B 404 or 420. Primarily mammalian physiology. Muscle physiology, neuroendocrine, endocrine, muscle, temperature regulation, 520. Body fluids, respiratory, renal, cardiovascular, immunology, metabolism.


590. Special Topics. Cr. 1 to 0. Prereq: Permission of instructor.
A. Physiology
B. Pharmacology

Courses for Graduate Students, major or minor


631. Experimental Techniques in Physiology. (2-6) Cr. 4. Alt. S. Prereq: offered 1982. Prereq: 552. Hombrough, staff. Possession of surgical skills recommended. Basic physiology in animals utilizing various techniques such as fistulas, bypasses, blood flow determinations, and others.
For the degrees Master of Science and Doctor of Philosophy, the foreign language requirement, if any, is established on an individual basis by the student’s program of study committee. For the nonthesis Master of Science degree, the student must complete at least 50 credit hours of acceptable work, including a WR 590 creative component acceptable to the student’s program of study committee.

Water Resources Courses
The interdepartmental water resources major consists of the three-semester sequence in water resources relating to (1) water quantity, (2) water quality, and (3) water resources economics and institutions. In addition, a special topics category and a water resources seminar category are offered. The Water Resources Interdepartmental Supervisory Committee encourages appropriate use of the water resources seminar, and will make it available insofar as possible both spring and fall semester. Appropriate interdisciplinary field trips to resource locations in Iowa and the Midwest are encouraged, particularly during the summer sessions.

Courses Primarily for Graduate Students, major or minor, open to qualified undergraduates

577. Water Resources I. (C E 577) (3-0) Cr. 3. F. Prereq: Permission of Water Resources Supervisory Committee. Introduction to water resources planning. Hydrology, including source, distribution and measurement of water; water management categories and beneficial use groups; demand for water; hydraulics and water control facilities. Administered by Civil Engineering Cooperative with Agriculture Engineering, Agronomy, and Earth Sciences.

578. Water Resources II. (C E 578) (3-0) Cr. 3. S. Prereq: Permission of Water Resources Supervisory Committee. Water resources planning. The role of quality in water resources: physical, chemical, and biological aspects of water and waste water. Administered by Civil Engineering Cooperative with Animal Ecology, Botany, and Food Technology.

579. Water Resources III. (Environ. 579) (3-0) Cr. 3. S. Prereq: Permission of Water Resources Supervisory Committee. Water resources planning. Water management categories and beneficial use groups; water demands for various uses. Legal, economic, sociological, governmental and technical aspects of water resources planning and management. Emphasis on systems of rational allocation among competing demands for water. Administered by Economics, cooperative with Sociology, Political Science, and other cooperating departments.

590. Special Topics. Cr. Var. Prereq: Permission of major professor in cooperating department. Literature reviews and conference in accordance with needs and interest of the student. Creative component for nonthesis master of science degree.

690. Seminar in Water Resources Management. (1-0) Cr. 1. F.S. Prereq: Permission of Water Resources Supervisory Committee and major professor.

Wildlife Biology
For description of courses, see Animal Ecology.

Zoology

John B. Balinsky, Chair of Department

The Graduate Faculty

Members: Balinsky, Bishop, Blausenstein, Brown, Buttry, Dolphin, Drewes, Emery, Hallberg, Hoffman, Jeska, Mayfield, Mutchmor, Powell, Redmond, Shaw, Ulmer

Associate Members: Baker, Bradley, Carlson, Ellis, Farrar, Forbes, Shen, Viles

Graduate Study

The department offers work for the degrees Master of Science and Doctor of Philosophy with majors in zoology, or molecular, cellular, and developmental biology. Both degrees require the completion of original research and written thesis or dissertation. A student majoring in zoology may specialize in animal behavior; cell biology; molecular biology; developmental biology; comparative physiology, ecology; endocrinology, immunobiology; neurobiology; parasitology; physiology. In addition to the program in Molecular, Cellular and Developmental Biology, the department also participates in the interdepartmental program in Immunobiology. (See Index.)

Students entering the graduate program in the department must be committed to research and need a sound background in the biological, physical, and mathematical sciences.

Applicants are required to submit Graduate Record Examination (GRE) scores for both the aptitude and the biology advanced area tests. Specific course requirements for advanced degrees depend largely upon previous training and experience in the major area of specialization. There is no foreign language requirement for the M.S. degree. Proficiency in one foreign language is required for the Ph.D. degree. The student's committee may require additional language competence. Certification in the use of written English is also required. All graduate students must acquire teaching experience in laboratory courses as part of their graduate program.

During the summer certain graduate courses in zoology are taught, and special research projects are supervised. At the Iowa Lakeside Laboratory, Lake Okoboji.

Courses for Graduate Students, minor only


434. Developmental Biology. (3-0) Cr. 3. F. Prereq: 204L. Key concepts, experiments, and observations of developmental biology.

434L. Developmental Biology Laboratory. (0-0) Cr. 2. F. Prereq: Credit or classification in 434. Observations and experiments on developmental aspects of selected organisms.

Courses for Graduate Students, major or minor, open to qualified undergraduates

505. (405 DL) Advanced Invertebrate Zoology. (3-0) Cr. 3 or (3-0) Cr. 3. Alt. F., offered 1982. Prereq: 325 or 355; permission of instructor to enroll in lab. Graduate study in conjunction with 405. In-depth study of selected invertebrate groups; analysis of research topics. Not open to students who have credit in 325.

506. Host-Parasite Systems. (Micro 506) (2-0) Cr. 2. F. Prereq: A course in parasitology. Detailed examination of host-parasite relationships involving parasitic helminths, protozoa and arthropods.


528. Cellular Growth and Regulation. (3-0) Cr. 3. F. Prereq: Courses in cell biology and biochemistry. Cell cycle, regulation of cell growth, cell division, membranes, transport processes, and regulation of cellular activities.

534. Molecular Development and Differentiation. (3-0) Cr. 3. S. Prereq: Courses in developmental and cell biology. Molecular biology of eucaryotic cells emphasizing developmental events.


551. Advanced Vertebrate Physiology I. (4-3) Cr. 5. F. Prereq: 355; 520 or B M E 525, credit or classification in B B 420 or 404. Neurophysiology, sensory systems, muscle, neuroendocrinology, endocrinology.

552. Advanced Vertebrate Physiology II. (4-3) Cr. 5. S. Prereq: 355; 520 or B M E 525, credit or classification in B B 420 or 404. Cardiovascular, renal, respiratory physiology, and digestion.

554. (454 DL) General and Comparative Endocrinology. (3-0) Cr. 3 or (3-3) Cr. 4. Alt. S., offered 1983. Prereq: 355, a course in biochemistry. Graduate study in conjunction with 454 Chemical integration of vertebrate organisms. The structure, development, and evolution of the endocrine glands and the function and structure of their hormones. Laboratory techniques for studying hormonal phenomena.

556. (456 DL) Introduction to Neurobiology. (3-0) Cr. 3 or (3-3) Cr. 4. S. Prereq: 355 or Psych 311; physics recommended; permission of instructor to enroll in lab. Graduate study in conjunction with 456. Integration, coding, plasticity, and development in nervous systems.

559. (459 DL) Environmental Physiology. (3-0) Cr. 3 or (3-3) Cr. 4. Alt. F., offered 1981. Prereq: 355; physics recommended. Graduate study in conjunction with 459. Physiological adaptations to the environment with emphasis on vertebrates.


590. Special Topics. Cr. 1 to 5 each time taken. Prereq: Permission of instructor.

Courses for Graduate Students, major or minor


612. Current Topics in Parasite Ecology, Evolution and Systematics. (Micro 612) Cr. 2-3 each time taken. Prereq: 506; permission of instructor. Critical study of current literature concerning specialization of parasites in relation to specific microenvironments, parasite population biology and behavior, modern approaches to systematics.

630. Current Topics in the Cellular and Molecular Biology of Animal Systems. Cr. 2-3 each time taken. Prereq: 528. Topics from cell organel function, cellular interactions, and eucaryotic molecular biology.

631. Advanced Developmental Biology. Cr. 2-3 each time taken. Prereq: 535; permission of instructor. Topics from comparative physiology, developmental biology, mammalian physiology, selected physiological techniques.

632. Cellular Regulation. Cr. 2-3 each time taken. Prereq: 528 or B B 526. In-depth analysis of selected cellular control mechanisms. Emphasis on the regulation of protein levels and the action of selected hormones on cell function.

633. Comparative Molecular Physiology. Cr. 2-3 each time taken. Prereq: 355 and 1 year of biochemistry. Selected topics on comparative aspects of energetics, anaerobiosis, anhydrobiosis, nitrogen metabolism, ionic and osmotic regulation. Emphasis on lower vertebrates and invertebrate animals.

650. Current Topics in Physiology. Cr. 2-3 each time taken. Prereq: 355; permission of instructor. Topics from comparative physiology, environmental physiology, mammalian physiology, selected physiological techniques.


655. Insect Physiology. (Ent 655) See Entomology.

660. Current Topics in Neurobiology and Behavior. Cr. 2-3 each time taken. Prereq: Permission of instructor. Topics may include communication, hormones and behavior, neural integration, neuroanatomy and ultrastructure, sensory biology, social behavior, techniques in neurobiology and behavior.

690. Seminar in Zoology. Cr. 1 each time taken. Offered on a satisfactory-fail basis only. A. Cellular, Molecular, and Developmental Biology B. Invertebrate Zoology and Parasitology C. Neurobiology and Behavior D. Physiology

698. Seminar in Molecular, Cellular, and Developmental Biology. (MCDB 698) See Molecular, Cellular, and Developmental Biology.

699. Research.

*Courses Offered at the Iowa Lakeside Laboratory

302L. (L:101) Field Biology. (4-12) Cr. 2-5. SS. Animals in the field, with particular emphasis on their classification and behavior. Emphasis on collecting, preserving, and laboratory culture methods. Field trips. Must be taken concurrently with Bot 301L.


490Z. Independent Study. (See preceding section.)

508L. (L:103, L:104) Aquatic Ecology. (8-24) Cr. 5 each. SS. 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.


516L. (L:110) Sympatric Relationships. Cr. 5. SS. Prereq: 15 credits in zoology. Field and laboratory studies of the major types of symbioses, including commensalism, parasitism, and mutualism. Emphasis on field studies of relationships involving aquatic animals of the Okoboji region. For advanced undergraduates and graduate students.

590. Special Topics. (See preceding section.)

699. Research. (See preceding sections.)

**Courses Offered at the Gulf Coast Research Laboratory, Ocean Springs, Mississippi


307G. Marine Invertebrate Zoology. Cr. 6 SS. Prereq: 24 credits in zoology, including an introductory course in invertebrate zoology. Concentrated study of free-living, marine invertebrates of the Mississippi Sound and adjacent continental shelf of the southeastern Gulf of Mexico. Emphasis on structure, classification, phylogeny, larval development, and functional processes.

320G. Marine Vertebrate Zoology and Ichthyology. Cr. 6 SS. Prereq: 24 credits in zoology, including comparative anatomy. General study of marine chordates, including fishes, amphibians, reptiles, birds and mammals. Emphasis on fishes.

*Written permission of the instructor is prerequisite to all courses offered at the Iowa Lakeside Laboratory. For current information concerning courses, registrations, 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.

**Written permission of the coordinator of the Gulf Coast Research Laboratory, 201 Bessey Hall, Iowa State University, Ames, Iowa, 50011, is prerequisite to all courses offered at the Laboratory.


BEECH, H. Z., Associate Professor of Foreign Languages and Literature, B.A., 1968, Moscow State; M.S., 1970, Oregon State, 1970.


*BERNARD, ROBERT W., Professor of Foreign Languages and Literatures, B.A., 1958, St. Thomas; M.A., 1966, Kansas State, 1966.

BEECH, H. Z., Associate Professor of Foreign Languages and Literature, B.A., 1968, Moscow State; M.S., 1970, Oregon State, 1970.


BEECH, H. Z., Associate Professor of Foreign Languages and Literature, B.A., 1968, Moscow State; M.S., 1970, Oregon State, 1970.
GONZO, SUSAN

GOEBEL, ROBERT

HAGEMOSER, WAYNE

GWIASDA, EMIL

GRIER, RONALD

GREER, MARY HELEN, Associate Professor of Medical Sciences.

GRAUPERA, ARTURO

GROSSMAN, ALLEN S., Professor of Physics.

Computation Center.

GROSSMAN, ALLEN S., Professor of Physics.

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KROHN, J., Professor of Physics, B.S., 1950, M.A., 1951, Ph.D., 1954, California.


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MIZE, CARL W., Associate Professor of Forestry. B.A., 1969, Brockport; M.S., 1973, Humboldt; Ph.D., 1977, Syracuse.


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