Clemson Graduate Announcements

1955

Clemson Graduate School Catalog, 1955-1956

Clemson University

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ANNOUNCEMENTS OF

The Graduate School

FOR 1955 - 1956
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COLLEGE CALENDAR

SUMMER TERM 1955

Matriculation, new students ........................................ June 13
Matriculation and Registration ..................................... June 14
Classes begin .................................................................. June 15
Independence Day Holiday ............................................. July 4
Examinations .................................................................. August 10, 11
Graduating Exercises ..................................................... August 13

SESSION 1955-1956

Matriculation, new students ........................................... September 7
Registration, new students ............................................. September 12
Matriculation and Registration, former students September 12, 13
Classes begin .................................................................. September 14
Last day to add a subject ................................................ September 27
Last day to drop a subject without penalty ...................... October 11
State Fair holidays begin at 12 noon ............................... October 19
State Fair holidays end at 10 p.m. .................................. October 23
Thanksgiving holidays begin at 1 p.m. ............................... November 23
Thanksgiving holidays end at 10 p.m. ............................... November 27
Christmas holidays begin at 1 p.m. ................................. December 21
Christmas holidays end at 10 p.m. ................................. January 3
End of First Semester ..................................................... January 28
Mid-Year Graduating Exercises ....................................... January 29
Matriculation, new students ........................................... January 30
Registration, new students ............................................. February 1
Matriculation and Registration, former students February 2
Classes begin .................................................................. February 3
Last day to add a subject ................................................ February 16
Last day to drop a subject without penalty ...................... March 1
Easter holidays begin at 12 noon ..................................... March 29
Easter holidays end at 10 p.m. ....................................... April 2
Commencement .............................................................. June 3
PERSONNEL

OFFICERS OF THE ADMINISTRATION

Robert Franklin Poole, Ph.D., D.Sc., LL.D., Litt.D.
President

Andrew Joseph Brown, B.S.
Treasurer, Secretary of the Board of Trustees

*James Corcoran Littlejohn, B.S., D.Eng.
Business Manager

Graham Hamilton Hill
Acting Business Manager

Lee W. Milford, M.D.
Surgeon

Gustave Ernest Metz, B.S., M.A.
Registrar

Milton Dyer Farrar, Ph.D.
Dean of Agriculture

Jess Willard Jones, Ph.D.
Director of Agricultural Teaching

Francis Marion Kinard, A.B., A.M., Litt.D.
Dean, School of Arts and Sciences

Howard Louis Hunter, Ph.D.
Dean, School of Chemistry and Geology

William Harold Washington, B.S., M.S.
Dean, School of Education

James Hagood Sams, Jr., Ph.D.
Dean, School of Engineering

Hugh Monroe Brown, Ph.D.
Dean, School of Textiles

Hubert Judson Webb, Ph.D.
Dean, Graduate School

John Wallace Gordan Gourlay, B.A., B.L.S., A.M.L.S.
Director of the Library

* Retired October 1, 1954.

GRADUATE COMMITTEE

Hubert Judson Webb, Chairman

Grant William Anderson  Antonius Nicolas Johannes Heyn
Charles Homer Arndt    Lorenz Ditmar Huff
George Hubert Aull      Howard Louis Hunter
Hugh Monroe Brown       Jess Willard Jones
Gilbeart Hooper Collins Willis Alonzo King
John Murphy Cook        Ernest McPherson Lander, Jr.
Joseph Gray Dinwiddie, Jr. Charles Edward Littlejohn
Milton Dyer Farrar      John Edward Miller
Edwin Jones Freeman      William Gilbert Miller
Olen Branford Garrison  William Thomas Rainey, Jr.
John Baker Gentry, Jr.  James Hagood Sams, Jr.
Howard Emmitt Glenn     Frank Bonnell Schirmer, Jr.
Joseph Coleman Green    Rupert Taylor

Thomas Arlington White
INFORMATION

GENERAL INFORMATION

Clemson is a land-grant college, a state institution, and one of the A. and M. colleges which emphasizes agriculture and mechanical industries. Clemson is fully accredited by the Southern Association of Colleges and Secondary Schools.

The twenty-nine curriculums under the Schools of Agriculture, Arts and Sciences, Chemistry, Education, Engineering, and Textiles form a background of training for the hundreds of occupations in which Clemson graduates engage. In addition to the training for a specific occupation, each curriculum is broadened to include fundamental training in the occupational area as well as the worthwhile values of general education. Although the College is organized on the university plan of various schools, it retains its entity through the inter-relationships of schools and departments in providing a well-balanced educational program.

It is the primary purpose of the Graduate School to provide opportunities for comprehensive training in special fields, to instruct the student in methods of independent investigation and to foster the spirit of scholarship and research. It is the intention to reduce the routine requirements to a minimum. So far as they exist they are for the purpose of furnishing the discipline and methods for independent study and investigation. Courses of study, association with older investigators and other aids and methods are for the promotion of productive scholarship.

EXPENSES

The cost to South Carolina students for board, laundry, dormitory room, all fees and tuition will amount to $773.20 for the 1954-1955 session. Students from other states pay an additional $200. Thus, regular South Carolina students will make payments of $193.15 per quarter for room, board, laundry, all fees and tuition. In like manner, non-resident students will make payments of $243.15 per quarter. South Carolina students not living in the dormitories will make payments of $52.20 per quarter to the college for tuition and fees.

The cost to part-time graduate students varies according to the amount of work scheduled, as follows:

<table>
<thead>
<tr>
<th>Time</th>
<th>Credits</th>
<th>Cost</th>
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<tr>
<td>1/4-time</td>
<td>1-5</td>
<td>$9.95*</td>
</tr>
<tr>
<td>1/2-time</td>
<td>6-8</td>
<td>$18.40*</td>
</tr>
<tr>
<td>3/4-time</td>
<td>9-11</td>
<td>$26.85*</td>
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*Plus credit hour charge of $4 for S. C. students and $12.50 for non-residents.
Graduate Fellowships. Both Research and Teaching assistantships are available to outstanding graduate students. Students who are accepted in the Graduate School are eligible to apply for such aids. Assistantships and fellowships are normally awarded for the academic year. Where vacancies exist, however, they may be granted for other periods. The minimum stipend for these appointments is normally $1200 for the academic year. Some appointments are for the calendar year and carry stipends of $1500 minimum. Half-time assistantships allow the student to carry an academic load of a maximum of 12 semester hours which is equivalent to three-fourths of the full load. Final selection for these fellowships and assistantships will be on a competitive basis and students interested in these awards should apply to the department in which they desire to study.

At the present time the Dow Corning Corporation Fellowship is available for students desiring to study in the field of Textile Chemistry.

The Edward Orton, Jr., and Zonolite Fellowships are available for students desiring to study in the field of Ceramic Engineering. The South Carolina Ceramic Manufacturers have also made funds available for assistantships for students working in this field.

EDUCATIONAL BENEFITS FOR VETERANS

Public Law 550. Eligible veterans who have served in the active service in the Armed Forces for ninety days or more during the period beginning June 27, 1950, and who have been discharged or released from active service under conditions other than dishonorable, may qualify for a program of education or training under Public Law 550, "Veterans' Readjustment Assistance Act of 1952."

In general each eligible veteran shall be entitled to education or training for a period equal to one and a half times the duration of his active service in the Armed Forces during the basic service period with a maximum period of entitlement of thirty-six months.

Information and forms for the filing of applications for assistance are provided by the Veterans' Administration.

Each eligible veteran enrolled in a program of education under this act will receive an allowance for the expenses of his subsist-
ence, tuition, fees, supplies, books and equipment. For veterans enrolled on a full-time basis, allowances will be computed at the rate of $110 per month, if the veteran has no dependent, or at $135 with one dependent, or $160 with more than one dependent.

**Public Laws 16, 346, and 894.** For veterans qualified for benefits under Public Law 16, 346, or 894, the Veterans' Administration pays tuition, fees and the cost of necessary books and supplies. The veteran pays his own living expenses but the subsistence checks to be received by the veteran will more than reimburse him for the cost of living in the dormitories at Clemson.

**BUILDINGS AND GROUNDS**

**Buildings.** Tillman Hall houses the offices of the President, the Registrar, the Commandant, the Treasurer, the Business Manager, and the Dean of the School of Arts and Sciences. This building also has over twenty classrooms. At the north end of the building is Memorial Hall, the College Auditorium, with a seating capacity of about eighteen hundred.

The Library Building, located in approximately the center of the campus, houses the Main Library, the Agricultural Reference Department, the Museum, and the Browsing Room. The Mailing Room for the Experiment Station and Extension Departments is on the basement floor.

The Library contains 141,281 bound volumes, consisting of books, periodicals and U. S. Government Publications. In addition to the bound volumes the Library contains 768,637 unbound Federal, State, Experiment Station and Extension Service publications, 8,841 unbound periodicals and 10,799 pamphlets and clippings in the vertical subject file.

The Browsing Room is located in the basement of the Library Building, is beautifully and comfortably furnished, and contains many popular and attractive books, current magazines, and daily newspapers. It also contains the reserve book collection.

A Carnegie Collection of 1,270 recordings of classical and semiclassical music, books related to music, and turntables for playing records with earphones for listening are also in this room.
The Library Staff consists of nine professionally trained Librarians and several other non-professional assistants and clerical workers. A trained Librarian is always on duty to assist faculty and students.

The Library is open daily from 8 a.m. until 10 p.m., Monday through Friday, from 8 a.m. to 5:30 p.m. Saturdays, and from 2 p.m. to 10 p.m. Sundays, with the exception of holidays.

The instructional work of the institution is maintained largely in the departmental buildings. The Schools of Agriculture, Chemistry, Engineering and Textiles have individual buildings especially designed for their purposes as do the Departments of Agricultural Engineering, and Ceramic Engineering. The School of Arts and Sciences is located in the Administration Building and the Physics Building with the exception of the Social Sciences Department which is located in the Old Chemistry Building, also occupied by the School of Education. Certain laboratory work is conducted at the greenhouses, livestock farms, poultry plant, veterinary hospital and other buildings on the college farm. The Department of Military Science has offices and classrooms in the Administration, Physics, and Old Education Buildings while the Department of Air Science is located in the Textile Building.

Fort Hill, the former home of John C. Calhoun, is located on the Clemson campus. In accordance with the provisions of Mr. Clemson's will, this residence has been made a shrine in honor of Mr. Calhoun. Several pieces of furniture and other interesting relics, formerly the property of Mr. Calhoun, are carefully preserved in this home, where they may be seen by visitors to the college.

Grounds. The college grounds comprise about 1,645 acres, including the campus, the farm, and the Experiment Station grounds. The two-hundred-acre campus is laid out in walks, drives and lawns, and is shaded by a beautiful grove of native forest trees.

Housing Facilities

The college has just completed, at a cost of over four million dollars, a student dormitory building program. The new dormitories in the form of a quadrangle and containing approximately 1,000 rooms, represent the latest in architectural design and are of modern steel and concrete construction. As a result of this build-
ing program, the college is able to house all students two per room in modern facilities, all of which were constructed since 1935. In addition to the rooms for students the new building program includes a student union section. This section includes a spacious lobby, and information center, a visitors' lounge, meeting rooms for the various clubs and student activities, a small chapel, a student canteen, a barber shop, and the dining hall.

**Family Housing.** The college has two hundred and eighty-seven houses for married students. These houses are equipped with space heaters and hot water heaters. The monthly rental ranges from $16.50 to $19.00 depending upon the type of kitchen appliances used.

Information concerning housing facilities may be obtained by writing the Clemson Housing Office.

**STUDENT HEALTH SERVICE**

The Surgeon, who has complete charge of the hospital, is one of the regular officers of the College, and his special duty is to look after the health of the students.

At a specified time every day, students who desire may consult the Surgeon, and those who are admitted to the hospital are cared for by experienced nurses in the college hospital. In case of necessity students are allowed to consult the Surgeon at any time, or send for him in an emergency.

The Surgeon cannot undertake to notify parents every time a student reports to the hospital for medicine, or for rest on account of some slight complaint. However, they may rest assured that they will be notified at once of sickness of any consequence.

The medical fee paid by each student is intended to cover all ordinary cases of sickness and their treatment. It is not intended to cover fees of doctors or specialists called into consultation, for performing operations, for special nurses, or for any medical or surgical attentions performed away from the College; and the College does not assume any responsibility for accidents that happen away from the College. Such expenses must be borne by the parents. The right of the College Surgeon, with the approval of the President of the College, to incur in behalf of any student under his care any of these extra services is hereby expressly reserved.
ORGANIZATION AND GOVERNMENT

ADMINISTRATIVE ORGANIZATION

Board of Trustees. The government of the College is vested in a Board of thirteen members, six of whom are elected by the Legislature, and seven life and self-perpetuating under the Clemson will. The function of this Board is legislative and not executive. The Board determines the general policy of the College, makes the laws for its government, and directs the expenditure of its funds.

The President is the chief executive and administrative officer appointed by the Board of Trustees. He is the head of the College and is responsible for its satisfactory working and success.

The College is divided into schools of Agriculture, Arts and Sciences, Chemistry, Education, Engineering, and Textiles. A dean is at the head of each school and is responsible to the President for its conduct and success. The schools are comprised of departments. Each department is in charge of a professor who acts as its head. The President conducts all official business with each department through its dean.

The Graduate School. The Dean is the Administrative Officer of the Graduate School and is also Chairman of the faculty committee on graduate work. This committee determines policies and regulations involving graduate work at the college. Inquiries about admission should be addressed to The Director of Admissions, Box 72, Clemson, South Carolina. Inquiries about assistantships and facilities for advanced study and research should be addressed to the Department in which such work is to be done.

No effort has been made to set up a graduate faculty as such. Those who teach courses for which graduate credit is given are considered members of the graduate faculty although they do not function as a distinct body.
DEGREES AND CURRICULUMS

GENERAL REQUIREMENTS AND REGULATIONS

Courses and Degrees. Courses are offered leading to the degree of Master of Science, Master of Mechanical Engineering, Master of Electrical Engineering, and Master of Civil Engineering. The Doctor of Philosophy is offered in Plant Pathology.

The College also offers the following professional engineering degrees: Civil Engineer, Electrical Engineer and Mechanical Engineer. The requirements for these degrees are: (a) a Bachelor's degree from Clemson College in one of these three branches of engineering, (b) five years of subsequent professional experience, one year of which must have been in responsible charge of engineering or engineering instruction, (c) the preparation of a thesis demonstrating distinct technical ability. These professional engineering degrees are not administered by the Graduate School. (Detailed information regarding professional degrees may be obtained from the Registrar.)

A list of major fields and courses acceptable for graduate credit is listed elsewhere in this bulletin. Certain courses of the 300 and 400 series are acceptable for graduate credit under conditions outlined under "course work required." The name and catalog number of these 300 and 400 courses are listed in this bulletin. Complete descriptions of these courses can be found in the General Catalog which may be obtained from the Registrar.

Admission. Before admittance to the Graduate School a student must have the Bachelor's degree from an institution with a scholastic rating satisfactory to the college, and must have the approval of the Head of the Department in which he plans to do his major work. For unconditional admission to the Graduate School the applicant must have an average undergraduate grade of B or better in the major field and should be in the upper half of his class. If the previous scholastic training is not considered adequate, the student may be required to make good the deficiency by doing additional supplementary work and lengthening the time required to obtain the degree.

With the approval of their Dean or Director, qualified, full time employees of the Clemson Agricultural College, may pursue gradu-
ate work for credit. Members of the faculty, experiment station or extension service staff or other staff members having a rank higher than Instructor or its equivalent, may not, however, be considered as candidates for advanced degrees at this Institution.

Students desiring to enroll in the Graduate School must make application to the Director of Admissions. The application should be accompanied by a transcript of previous college work, and by such written recommendations as are necessary in support of the application. Within one month after registering for graduate credit the student must file with the Dean of the Graduate School his Preliminary Plan of Graduate Study, G. S. Form 2. Admission to the Graduate School does not automatically qualify a student as a candidate for an advanced degree. A written application for the degree must be presented to the Dean of the Graduate School at least three months before the convocation in which the degree is expected. This application must list the major and minor subjects to be offered for the degree and must be accompanied by the outline of a proposed thesis. It must bear the signed approval of the heads of the departments and the professors concerned.

Seniors who are within one semester of graduation and who have grade-point ratios of 3.3 or above may be permitted to register for courses of the 500 series provided their total load is not more than 15 hours, and provided such 500 courses are in addition to the requirements for the undergraduate degree. These courses will not be recorded as graduate credit, but if these students are subsequently admitted to the graduate school at this institution they may request that these courses be included as a part of their graduate program.

Before a student is admitted to candidacy for an advanced degree he must present evidence that he has taken the Graduate Record Examination. This examination will be administered at Clemson in July and October, on the Institutional Testing Plan. A fee of $5.00 is charged for students participating in these tests. Application for these tests should be made at the Graduate School Office at least three weeks prior to the date of the examination. Students who do not take these examinations on these dates will be expected to make their own arrangements with the Educational Testing Service for the tests.
Maximum Credit Load. Fifteen credit hours per semester or one credit hour per week for the Summer School is the Maximum load for students who are devoting all of their time to graduate work. Persons who are employed on a full-time basis may not carry more than six semester credits per semester. The maximum graduate load for students devoting part-time to graduate study and part-time to staff duties will be determined by their terms of employment.

REQUIREMENTS FOR MASTER’S DEGREES

To receive the Master’s degree the student must spend the equivalent of at least one academic year in residence at the College as a graduate student. No graduate credit will be allowed for courses completed in less than six weeks. The Master’s degree must be obtained within a six-year period.

Course Work Required. In addition to such supplementary or supporting courses as may be required, the work will consist of a minimum of 30 semester hours of which six semester hours shall be research, on the basis of which a thesis is required. Of the remaining 24 semester hours, at least 12 hours must come from the courses numbered 500 or above. The additional credit hours (the minor or minors) are to be determined in consultation with the professors in charge of the work which is to require the major and minor interests of the student. Of the 24 course hours required, at least 12 hours must be in the major field and at least 6 hours in one minor. To receive graduate credit for a 300 or 400 series course the student must attain a grade of B or better. Graduate credit may be received for a grade of C on 500 series courses, provided, however, that the average grade for all 500 series courses must be B or better on a credit hour basis before the student can become eligible for an advanced degree.

In order to obtain graduate credit for a course numbered less than 500 the student must develop a complete program of graduate work leading to an advanced degree. This program should be approved by the Heads of the Major and Minor Departments and the Dean of the Graduate School before the student registers for such courses. Forms are provided by the Graduate School Office for filing this program.
As a rule, it is not permissible to select a minor in the same field as the major. No student shall receive both graduate and undergraduate credit for the same course.

**Transferred Credits.** Credits obtained in a different but recognized institution, not exceeding six semester hours, may be transferred and credited to the Master's degree provided that the work was of graduate character and provided that transferred credit does not reduce the minimum residence period of one academic year. No credit toward graduate degrees may be obtained by correspondence or extension study.

**Language Requirement.** A reading knowledge of one modern language is required by some departments.

**Recommendation for Degree.** Each candidate for an advanced degree, after the completion of the required thesis, and at least two weeks before it is expected that the degree will be awarded, must pass such examination as may be required by a committee to be appointed by the Dean of the Graduate School. This committee shall ascertain the general knowledge of the candidate with particular reference to the major and minor subjects and the thesis. It will report its findings and recommendations to the Dean of the Graduate School, who in turn, will present them to the Graduate Committee for appropriate action.

**REQUIREMENTS FOR THE DOCTOR OF PHILOSOPHY DEGREE**

Work leading to the Doctor of Philosophy degree is planned in such a way as to give the student a comprehensive knowledge of his fields of specialization and mastery of the methods of research. The degree is not awarded solely on the basis of course work completed, residence or other routine requirements. The final basis for granting the degree will be the student's grasp of the subject matter of a broad field of study, his demonstrated ability to plan and carry out research, and his ability to express himself in both oral and written language.

**Residence Requirements.** To receive the Doctor of Philosophy degree the student must spend the equivalent of at least three academic years in full residence as a graduate student. At least one academic year must be in continuous resident study at this institution.
**Time Limit.** All work for this degree must be completed within a period of seven years. If the student begins his doctoral program after receiving the master's degree, all work above the master's level must be completed within a six year period.

**Language Requirement.** A reading knowledge of both French and German is required of all candidates for the doctorate. Other languages may be substituted in cases where it is demonstrated that it will be of more value in the particular specialty of the student. Such substitutions must be approved by the student's advisory committee and by the Dean of the Graduate School. All language requirements must have been satisfied prior to the preliminary or qualifying examination and prior to admission to candidacy for the degree.

**Student's Advisory Committee.** After the student is admitted to graduate study, the Dean of the Graduate School will, in consultation with the heads of the departments in which the student desires to concentrate, appoint a committee of three or more faculty members to act as an advisory committee to the student. This committee along with the graduate Dean will evaluate the student's previous training and prescribe prerequisites to cover deficiencies. Thereafter the student, in consultation with the advisory committee will outline a program of study to support his proposed research and fields of concentration.

**Major and Minors.** When a student applies for admission to graduate study he will designate a major field of study. Not later than the time of his initial registration he will also designate two fields which will be his minor fields of study. Each of these fields will be represented on his advisory committee.

**Qualifying Examinations and Admission to Candidacy.** The student must undertake a preliminary or qualifying examination at least one academic year before he expects to obtain the degree. These examinations will be conducted by the advisory committee and the faculty representing the major field of study. The examinations may be written, oral or a combination of both at the discretion of the committee and faculty concerned.
The student's performance on these examinations will determine whether or not the committee is justified in recommending him for admission to candidacy for degree.

**Thesis.** The ability to plan and perform independent research must be demonstrated by a thesis. In addition to its scholarly merit the thesis must evidence creditable literary ability.

The student should identify his research problem as early in his graduate program as possible in order to permit time to complete course work which will support the proposed research.

The thesis must be completed and accepted by the advisory committee at least two weeks prior to the final oral examination. After the thesis is accepted the student will request the chairman of his advisory committee to arrange and schedule the final examination.

**Final Examination.** The candidate for the Doctor of Philosophy degree must pass a final oral examination at least two weeks prior to the time of the commencement at which he plans to obtain the degree. The examination will be conducted by the student's advisory committee, and all faculty members will be invited to participate. The Graduate School Office will be notified of the time and place of the examination at least ten days prior to the time scheduled.
DESCRIPTION OF COURSES

AGRICULTURAL CHEMISTRY

Ag Ch 411—AGRICULTURAL CHEMISTRY—4 cr. (2 and 6)  Mr. Webb
Ag Ch 412—AGRICULTURAL CHEMISTRY—4 cr. (2 and 6)  Mr. Webb
Ag Ch 421—GENERAL BIOCHEMISTRY—3 cr. (3 and 0)    Mr. Mauldin
Ag Ch 422—GENERAL BIOCHEMISTRY—3 cr. (3 and 0)    Mr. Mauldin

AGRICULTURAL ECONOMICS

Ag Ee 352—PUBLIC FINANCE—3 cr. (3 an 0)              Mr. Aull, Mr. Stepp
Ag Ee 357—CONSERVATION OF NATURAL RESOURCES—3 cr. (3 and 0)  Mr. Aull, Mr. Bauknight
Ag Ee 401—STATISTICS—4 Cr. (3 and 3)                 Mr. Todd
Ag Ee 451—AGRICULTURAL COOPERATION—2 cr. (2 and 0)  Mr. Ferrier, Mr. Todd
Ag Ee 452—AGRICULTURAL POLICY—3 cr. (3 and 0)       Mr. Aull
Ag Ee 456—PRICES—3 cr. (3 and 0)                     Mr. Todd
Ag Ee 460—AGRICULTURAL FINANCE—2 cr. (2 and 0)      Mr. Ferrier, Mr. Bauknight
Ag Ee 462—APPLIED STATISTICS—3 cr. (2 and 3)         Mr. Todd
Ag Ee 501—ADVANCED FARM MANAGEMENT—3 cr. (2 and 3)  Mr. Aull

Study and appraisal of methods of assembling and analyzing information concerning the business of farming. Prerequisites: Ag Ee 302 and Ag Ee 401.

Ag Ee 503—LAND ECONOMICS—3 cr. (3 and 0)             Mr. Bauknight

A study of the characteristics of land and its utilization in relation to population and public policies. Prerequisite: Permission of instructor.

Ag Ee 505—ECONOMIC THEORY—3 cr. (3 and 0)            Mr. Aull

A review of economic principles, a study of the use of theory in the analysis of economic problems, and an appraisal of recent developments in capitalistic economic theory. Prerequisites: Permission of instructor.

Ag Ee 507—AGRICULTURAL MARKETING PROBLEMS—3 cr. (3 and 0)  Mr. Stepp

A study of special problems involved in research and marketing southern fruits, vegetables, livestock and livestock products. Students will undertake individual assignments in the field of their interest. Prerequisites: Ag Ee 309 or permission of instructor.

Ag Ee 512—EXPERIMENTAL DESIGNS—3 cr. (3 and 0)

An examination of the ways to plan and conduct comparative experiments so they will provide, efficiently, specific answers to scientific ques-
tions under investigation. **Prerequisite:** Ag Ec 401 or permission of instructor. Mr. Todd

Ag Ec 514—CONTEMPORARY ECONOMIC PROBLEMS—3 cr. (3 and 0)
A critical review of the nature of contemporary economic problems, the background out of which they developed, the remedies which have been applied and possible alternatives. (Special emphasis will be given to problems relating to agriculture and rural life.) **Prerequisite:** Permission of instructor. Mr. Aull

Ag Ec 591—RESEARCH—3 cr. Mr. Aull and Staff
Ag Ec 592—RESEARCH—3 cr. Mr. Aull and Staff

**AGRICULTURAL ENGINEERING**

Ag En 401—SOIL AND WATER CONSERVATION ENGINEERING—3 cr. (2 and 3) Mr. Snell

Ag En 402—DRAINAGE AND IRRIGATION—3 cr. (2 and 3) Mr. Snell

Ag En 451—FARM STRUCTURES—3 cr. (2 and 3)

Ag En 452—ADVANCED FARM STRUCTURES—3 cr. (2 and 3)

Ag En 501—SPECIAL PROBLEMS IN AGRICULTURAL ENGINEERING—3 cr. (3 and 0)
Each student will select a subject pertaining to his particular interest or major field of study in Agricultural Engineering. Library and/or laboratory research will be conducted and a technical report will be written. The subject may be selected from one of the following: (a) Power and Machinery, (b) Soil and Water, (c) Farm Structures, or (d) Rural Electrification. **Prerequisite:** Graduate standing and permission of instructor.

Ag En 511—DESIGN OF FARM MACHINERY—3 cr. (3 and 0)
A study of the design and selection of the mechanical units of machines will be made with emphasis on their application to the agricultural implement field. **Prerequisite:** Mech 304 and Ag En 406.

Ag En 512—DESIGN OF FARM MACHINERY—3 cr. (2 and 3)
Problems in agricultural implement design will be chosen to coordinate the design of functional units of farm machines with the selection of machine members. **Prerequisite:** Ag En 511.

Ag En 522—ADVANCED DRAINAGE & IRRIGATION ENGINEERING—3 cr. (3 and 0)
A study of theory and principles of drainage, irrigation and water storage. Principal topics include theory and application of flow of water through soil in unsaturated and saturated states, flow nets and seepage forces, and the fundamentals of engineering design with respect to ground water problems and soil moisture relationships. **Prerequisite:** Ag En 401, 402 or by special permission. Mr. Snell

Ag En 591—RESEARCH—3 cr.
Ag En 592—RESEARCH—3 cr.
AGRONOMY

Agron 301—FERTILIZERS AND MANURES—3 cr. (3 and 0) Mr. Collings
Agron 302—GENETICS—3 cr. (2 and 3) Mr. C. M. Jones
Agron 306—FORAGE CROPS AND WEED IDENTIFICATION AND CONTROL—4 cr. (3 and 3) Mr. Shelley
Agron 409—COTTON AND TOBACCO—3 cr. (3 and 0) Mr. Shelley
Agron 451—MINERAL NUTRITION OF PLANTS—2 cr. (2 and 0) Mr. Cooper
Agron 452—SOIL CLASSIFICATION, FERTILITY, AND MANAGEMENT—2 cr. (2 and 0) Mr. Collings
Agron 455—SEMINAR—1 cr. (1 and 0) Mr. Cooper
Agron 456—SEMINAR—1 cr. (1 and 0) Mr. Collings
Agron 501—ADVANCED NUTRITION OF CROPS—3 cr. (3 and 0) Mr. Cooper
Agron 502—ADVANCED PEDOLOGY AND SOIL CLASSIFICATION—3 cr. (3 and 0) Mr. Collings
Agron 503—ADVANCED CROP PRODUCTION—3 cr. (3 and 0) Mr. C. M. Jones
Agron 504—ADVANCED PLANT BREEDING AND GENETICS—3 cr. (3 and 0) Mr. C. M. Jones
Agron 505—ADVANCED SOIL FERTILITY—3 cr. (3 and 0) Mr. Pitner
Agron 591—RESEARCH—3 cr.
Agron 592—RESEARCH—3 cr.
ANIMAL HUSBANDRY

AH—310, 314—PORK PRODUCTION—3 cr. (2 and 3) Mr. Starkey, Mr. Cook
AH 401, 403—BEEF PRODUCTION—3 cr. (2 and 3) Mr. Starkey, Mr. Ritchie
AH 451—ADVANCED FEEDS—2 cr. (2 and 0) Mr. Wheeler
AH 452, 454—ANIMAL BREEDING—3 cr. (2 and 3) Mr. Godley
AH 455—FARM MEATS—2 cr. (0 and 6) Mr. Wheeler, Mr. Handlin
AH 456—ADVANCED MEATS—1 cr. (1 and 0) Mr. Wheeler
AH 502—TOPICAL PROBLEMS—1-3 cr. (1-3 and 0)
A critical study of Animal Husbandry Experiments and the interpretation of their results. Intended to prepare students for positions with agricultural colleges and experiment stations and the United States Department of Agriculture.
AH 504—METHODS IN ANIMAL BREEDING—3 cr. (3 and 0)
A study of factors governing gene and zygotic frequency; systems of mating; heritabilities; genetic consequences of selection; and criteria for evaluating improvement in beef cattle, swine, and sheep. Mr. Godley
AH 505—NUTRITION OF MEAT ANIMALS—3 cr. (3 and 0)
A course dealing with the metabolism of carbohydrates, lipids, proteins, inorganic elements, and vitamins in the nutrition of beef cattle, swine, and sheep; the nutrient requirements of meat animals with special emphasis on the properties and functions of nutrients. Mr. Wheeler
AH 591—RESEARCH—3 cr.
AH 592—RESEARCH—3 cr.

ARCHITECTURE

Arch 301—ARCHITECTURAL DESIGN—4 cr. (0 and 12) Mr. Means
Arch 302—ARCHITECTURAL DESIGN—4 cr. (0 and 12) Mr. Means
Arch 318—WORKING DRAWINGS—2 cr. (0 and 6) Mr. Graves
Arch 401—ARCHITECTURAL DESIGN—6 cr. (0 and 18) Mr. Ellner
Arch 402—ARCHITECTURAL DESIGN—6 cr. (0 and 18) Mr. Ellner
Arch 409—ART APPRECIATION—3 cr. (3 and 0) Mr. St. Hubert
Arch 412—HISTORY OF ART—3 cr. (3 and 0) Mr. St. Hubert
Arch 415—STRUCTURAL METHODS—2 cr. (2 and 0) Mr. Stakely
Arch 418—WORKING DRAWINGS—2 cr. (0 and 6) Mr. Stakely
Arch 428—WORKING DRAWINGS—3 cr. (0 and 9)  
Arch 451—ARCHITECTURAL DESIGN—6 cr. (0 and 18)  
Arch 462—ENVIRONMENTAL PLANNING—3 cr. (3 and 0)  
Arch 465—ADVANCED CONSTRUCTION—2 cr. (1 and 3)

Mr. Gunnin  
Mr. Speer  
Mr. Ellner  
Mr. Gunnin

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**BACTERIOLOGY**

Bact 301, 303—GENERAL BACTERIOLOGY—4 cr. (3 and 3)  
Mr. Rush, Mr. Bond

Bact 310, 312—ADVANCED BACTERIOLOGY—4 cr. (2 and 6)  
Mr. Bond

Bact 402, 404—DAIRY BACTERIOLOGY—3 cr. (2 and 3)  
Mr. Rush

Bact 406, 408—SANITARY BACTERIOLOGY—4 cr. (3 and 3)  
Mr. Rush

Bact 410, 412—SOIL MICROBIOLOGY—3 cr. (2 and 3)  
Mr. Bond

Bact 501, 503—TAXONOMY OF BACTERIA—3 cr. (2 and 3)  
This course covers the history of determinative bacteriology, and the basic morphological, cultural, and physiological differences used in distinguishing between the various taxonomic groups of bacteria. Opportunity will be given in the laboratory to isolate and identify bacteria from natural sources. **Prerequisites:** Bact 301, 303, 310, 312, and organic chemistry.  
Mr. Bond

Bact 502, 504—ADVANCED BACTERIOLOGICAL TECHNIC—4 cr. (2 and 6)  
A course including methods of preparing special equipment for use in the bacteriological laboratory, sterilization by filtration, isolation of viruses, immunological procedures, and the experimental infection of animals. This course is designed to give students interested in research in the field of bacteriology and plant pathology experience in more advanced methods of investigation. **Prerequisites:** Bact 301, 303, Bot 401, 403.  
Mr. Bond

Bact 505, 507—PHYSIOLOGY OF BACTERIA—3 cr. (2 and 3)  
A study of bacterial cytology, enzymes, growth curves, respiration, aerobiosis, anaerobiosis, nutrition of bacteria and degradation of proteins, carbohydrates, and fats. **Prerequisites:** Bact 301, 303, 310, 312, and organic chemistry.  
Mr. Bond

Bact 591—RESEARCH—3 cr.

Bact 592—RESEARCH—3 cr.
Botany

Bot 351, 353—Plant Morphology—4 cr. (2 and 6) Mr. Rutledge
Bot 352, 354—Plant Physiology—4 cr. (3 and 3) Mr. Whitney
Bot 355—Histology—2 cr. (0 and 6) Mr. Rosenkrans
Bot 356, 358—Taxonomy—3 cr. (1 and 6) Mr. Rosenkrans
Bot 401, 403—Plant Pathology—3 cr. (2 and 3) Mr. Armstrong, Mr. Mathews
Bot 451, 453—Morphology of the Fungi—3 cr. (2 and 3) Mr. Mathews
Bot 501—Methods of Research in Plant Physiology—3 cr. (2 and 3)
   A theoretical and practical study of methods used in investigation of
   physiological processes and the factors influencing those processes. Topics
   include sand and solution culture methods, measurement and control of
   soil water content, atmospheric humidity and radiant energy, and determinations
   of osmotic quantities, hydrogen ion concentration, and metabolic
Bot 502—Advanced Mycology—3 cr. (2 and 3)
   A course designed chiefly for students majoring in mycology, plant
   pathology and closely allied fields. A detailed study is made of specific
   groups of fungi, especially those of economic importance of this region.
   Emphasis is placed on field collection, identification, morphology, and
   cytology through lectures and student reports and laboratory work. Prerequisites:
   Bot 356, 358, 451 and 453. Mr. Mathews
Bot 503—Advanced Plant Pathology—4 cr. (3 and 3)
   Essentially an introduction to research on plant diseases with review
   and recording of literature; preparation of media; isolation of single-cells
   of organisms in pure culture; a class study of infection and epidemiology
   of one fungus, one bacterial, and one virus disease; and an individual
   "problem" with preparation of a manuscript according to standards of a
   scientific journal. Prerequisites: Bot 401, 403.
Bot 504—Physiology of Parasitism in Plants—3 cr. (3 and 0)
   This course is designed to acquaint the student with the interaction of
   host and parasite as affected by environmental conditions and nutrition of
   the host. Emphasis will be given to the factors that influence infection
   and the development of the parasite within the host. Prerequisites: Bot
   351, 352, 353, 354, 401 and 403. Mr. Arndt
Bot 505—Special Problems in Plant Pathology—3 to 6 cr.
   Original investigation of special problems in plant pathology which are
   not related to a thesis but designed to provide experience and training in
   research. Prerequisite: Graduate standing and permission of instructor.
Bot 506—CHEMICAL CONTROL OF PLANT DISEASES—2 or 4 cr.  
(2 and 0 or 2 and 6)  
An introduction to the chemicals used in the control of plant diseases,  
the nature of their action on fungi, their application and methods of evalua-
tion. Laboratory facilities are available for qualified students who may  
wish to evaluate chemicals in respect to their effectiveness in the control  
of specific plant diseases. **Prerequisites:** Bot 401, 403, and organic  
chemistry.  
Mr. Arndt

Bot 591—RESEARCH—3 cr.

Bot 592—RESEARCH—3 cr.

CERAMIC ARTS

Cr Ar 301—POTTERY GLAZES—3 cr. (3 and 0)

Cr Ar 401—ADVANCED POTTERY—3 cr. (2 and 3)

CERAMIC ENGINEERING

Cr En 301—THE DRYING AND FIRING OF CERAMIC PRODUCTS—4 cr.  
(3 and 3)

Cr En 305—SILICATES—5 cr. (3 and 6)

Cr En 402—REFRACTORIES—3 cr. (3 and 0)

Cr En 403—WHITEWARES AND GLAZES—3 cr. (3 and 0)

Cr En 404—ENAMELS—3 cr. (3 and 0)

Cr En 410—GLASS—3 cr. (3 and 0)

Cr En 412—RAW MATERIAL PREPARATION—3 cr. (3 and 0)

Cr En 416—CEMENT, LIME AND PLASTER—3 cr. (3 and 0)

Cr En 418—PROCESS CONTROL—3 cr. (1 and 6)

Cr En 501—ADVANCED ANALYTICAL PROCEDURES AND EQUIP-
MENT—3 cr. (2 and 3)  
A study of the use and application of the X-ray, spectograph, and electron  
microscope in ceramics.  
Mr. Wilson

Cr En 502—SILICATE CRYSTALLOGRAPHY—3 cr. (3 and 0)  
A study of the basic laws of chemical crystallography and their appli-
cation to the structure of silicate minerals.  
Mr. Wilson

Cr En 503—CERAMIC PRODUCTION CONTROL—3 cr. (3 and 0)  
A study of the techniques and procedures for providing the required  
quantity and quality of materials at the required time and place in ceramic  
industries. Motion study, job analysis, job and wage evaluation in these  
industries.  
Mr. Wilson
Cr En 504—CERAMIC QUALITY CONTROL—3 cr. (3 and 0)
A study of organization and procedure for quality control in ceramic industries. Practices and techniques used for systematic control of ceramic products and materials. Mr. Wilson

Cr En 505—ADVANCED DRYING—3 cr. (2 and 3)
An advanced study of drying fundamentals, drying problems, and dryer design. Mr. Robinson

Cr En 506—ADVANCED FIRING—3 cr. (2 and 3)
An advanced study of fuels, combustion, heat transfer, firing problems, and firing equipment. Mr. Robinson

Cr En 507—SPECIALIZED CERAMICS—3 cr. (3 and 0)
An advanced study of one of the divisions of ceramics. The student may select either structural products, refractories, whitewares, abrasives, enamels, glass, elements, or raw materials processing. Mr. Robinson

Cr En 591—RESEARCH—3 cr.
Cr En 592—RESEARCH—3 cr.

CHEMICAL ENGINEERING

Ch En 301—PRINCIPLES OF CHEMICAL ENGINEERING—3 cr. (3 and 0) Mr. Berne-Allen

Ch En 302—PRINCIPLES OF CHEMICAL ENGINEERING—3 cr. (3 and 0) Mr. Littlejohn

Ch En 306—UNIT OPERATIONS—1 cr. (0 and 3) Mr. Littlejohn

Ch En 330—CHEMICAL ENGINEERING THERMODYNAMICS—2 cr. (2 and 0)

Ch En 401—PRINCIPLES OF CHEMICAL ENGINEERING—3 cr. (3 and 0) Mr. Littlejohn

Ch En 403—CHEMICAL INDUSTRIES—3 cr. (3 and 0) Mr. Berne-Allen

Ch En 404—CHEMICAL INDUSTRIES—3 cr. (3 and 0) Mr. Berne-Allen

Ch En 406—INDUSTRIAL CHEMICAL CALCULATIONS—2 cr. (2 and 0) Mr. Berne-Allen

Ch En 407—UNIT OPERATIONS—2 cr. (0 and 6) Mr. Littlejohn

Ch En 409—PLANT DESIGN—2 cr. (0 and 6) Mr. Berne-Allen

Ch En 415—INTRODUCTION TO NUCLEAR ENGINEERING—3 cr. (3 and 0) Mr. Littlejohn

Ch En 422—INDUSTRIAL WASTE TREATMENT—2 cr. (2 and 0) Mr. Berne-Allen

Ch En 430—CHEMICAL ENGINEERING THERMODYNAMICS—3 cr. (3 and 0) Mr. Littlejohn
CHEMISTRY

A graduate student who registers for graduate work in the School of Chemistry must have satisfactorily completed as a minimum the following undergraduate courses before he formally becomes a candidate for the degree. Anyone who has not satisfied these requirements before entering the graduate school will be required to include such courses in his graduate program, which may result in increasing the minimum number of credit hours necessary for his securing the Master's degree in Chemistry.

- One year of General Chemistry
- One year in Organic Chemistry
- One year of Physical Chemistry
- One course in Qualitative Analysis (if not included in General Chemistry)
- One course in Elementary Quantitative Analysis

A placement examination is required of each student at the time he begins his graduate program. A satisfactory performance is required on a comprehensive written examination at least two months prior to the final oral examination.

Before receiving his degree a student must demonstrate a satisfactory reading knowledge of a modern foreign language. This language will ordinarily be German unless some other language is recommended by the student's committee.

Either a major or minor may be taken in one or more of the following fields of Chemistry: Inorganic, Analytical, Organic or Physical. A minor may also be taken in some field other than Chemistry.

Chem 323—ELEMENTARY ORGANIC CHEMISTRY—4 cr. (3 and 3)  
Mr. Carodemos

Chem 324—ELEMENTARY ORGANIC CHEMISTRY—4 cr. (3 and 3)  
Mr. Carodemos

Chem 331—PHYSICAL CHEMISTRY—5 cr. (3 and 6)  
Mr. Hobson
Chem 332—PHYSICAL CHEMISTRY—5 cr. (3 and 6)  
Mr. Hobson
Chem 335—PHYSICAL CHEMISTRY—3 cr. (3 and 0)  
Mr. Hobson
Chem 336—PHYSICAL CHEMISTRY—2 cr. (2 and 0)  
Mr. Hobson
Chem 337—PHYSICAL CHEMISTRY—4 cr. (3 and 3)  
Mr. Hobson
Chem 338—PHYSICAL CHEMISTRY—4 cr. (3 and 3)  
Mr. Hobson
Chem 339—INTRODUCTION TO PHYSICAL CHEMISTRY—3 cr. (3 and 0)  
Mr. Dinwiddie
Chem 401—INORGANIC CHEMISTRY—2 cr. (2 and 0)  
Mr. Schirmer
Chem 402—INORGANIC CHEMISTRY—3 cr. (2 and 3)  
Mr. Schirmer
Chem 411—INSTRUMENTAL ANALYSIS—3 cr. (1 and 6) Mr. Brownley
Chem 421—QUALITATIVE ORGANIC ANALYSIS—3 cr. (1 and 6)
Mr. Carodemos
Chem 443—RESEARCH PROBLEMS—3 cr. (0 and 9)
Chem 444—RESEARCH PROBLEMS—3 cr. (0 and 9)
Chem 454—INORGANIC SYNTHESIS—2 cr. (0 and 6) Mr. Schirmer
Chem 472—ORGANIC SYNTHESIS—3 cr. (1 and 6) Mr. Carodemos
Chem 503—INORGANIC CHEMISTRY—2 cr. (2 and 0) A comprehensive review of the field of inorganic chemistry.
Mr. Schirmer
Chem 504—INORGANIC CHEMISTRY—2 cr. (2 and 0) A continuation of Chem 503 Mr. Schirmer
Chem 505—ADVANCED INORGANIC CHEMISTRY—3 cr. (3 and 0) A study of atomic crystal and molecular structure and its relationship to inorganic chemistry. Prerequisites: Chem 401 and 402 or 503 and 504. Mr. Schirmer
Chem 511—ADVANCED ANALYTICAL CHEMISTRY—3 cr. (3 and 0) This course includes error analysis, the elementary statistical theory involved in procedures, and design of experiments and certain industrial control methods. Selected methods for the determination of a few elements not covered in the elementary courses are discussed as well as the less commonly used physico-chemical methods. Prerequisites: Chem 331 and 332 or 530 and 531. Mr. Brownley
Chem 512—CHEMICAL SPECTROSCOPIC METHODS—3 cr. (2 and 3) This course is designed to give the student an understanding of the principles of spectroscopic procedures. Both absorption and emission techniques will be considered. Emphasis will be placed on ultraviolet and infrared as well as visible spectra. Mr. Brownley
Chem 520—INTERMEDIATE ORGANIC CHEMISTRY—3 cr. (3 and 0) A comprehensive review of the field of organic chemistry. Mr. Dinwiddie
Chem 521—ADVANCED ORGANIC CHEMISTRY—3 cr. (3 and 0) The object of this course is to give a general survey of organic chemistry with special attention given to the general types of organic reactions and to important processes. The lectures are supplemented by assigned problems and reports on current organic literature which are discussed during a weekly conference. Prerequisite: Chem 520. Mr. Dinwiddie
Chem 530—PHYSICAL CHEMISTRY—3 cr. (3 and 0) A comprehensive review of the field of physical chemistry. The student will also be required to take laboratory work if he has not been sufficiently well grounded previously in this phase of the subject. Prerequisites: Courses in qualitative and quantitative analyses, organic chemistry, and a working knowledge of integral calculus. Mr. Hobson
Chem 531—PHYSICAL CHEMISTRY—3 cr. (3 and 0)  
A continuation of Chem 530.  
Mr. Hobson

Chem 532—ADVANCED PHYSICAL CHEMISTRY—3 cr. (3 and 0)  
An advanced course covering special phases of physical chemistry such as recent advances in the theory of solutions, chemical kinetics, catalysis and phase equilibrium. **Prerequisites:** Chem 530 and 531.  
Mr. Hobson

Chem 541—ATOMIC AND MOLECULAR STRUCTURE—3 cr. (3 and 0)  
The purpose of this course is to strengthen the student's understanding of atomic structure and to extend his knowledge of the structure of molecules. Major emphasis will be given to studying the relationship of structure to physical and chemical properties with examples drawn from both the organic and inorganic fields.

Chem 591—RESEARCH—3 cr.

Chem 592—RESEARCH—3 cr.

**CIVIL ENGINEERING**

CE 305—ROUTE SURVEYING—3 cr. (2 and 3)  
Mr. Trively

CE 307—ROADS AND PAVEMENTS—3 cr. (2 and 3)  
Mr. Rostron

CE 309—TRUSSES—1 cr. (0 and 3)  
Mr. Lowry, Mr. Hunter

CE 310—STRUCTURES—3 cr. (2 and 3)  
Mr. Trively

CE 317—MATERIALS AND METHODS OF CONSTRUCTION—2 cr.  
(2 and 0)  
Mr. Lowry, Mr. J. D. Glenn

CE 401—STRUCTURAL DESIGN—3 cr. (2 and 3)  
Mr. Trively

CE 402—STRUCTURAL ANALYSIS—2 cr. (2 and 0)  
Mr. Trively, Mr. J. D. Glenn

CE 409—REINFORCED CONCRETE STRUCTURES—4 cr. (3 and 3)

CE 410—MUNICIPAL AND SANITARY ENGINEERING—3 cr. (2 and 3)  
Mr. Ford

CE 412—REINFORCED CONCRETE DESIGN—2 cr. (1 and 3)  
Mr. Trively

CE 414—SOIL MECHANICS—3 cr. (2 and 3)  
Mr. Hunter

CE 417—CITY PLANNING—2 cr. (2 and 0)  
Mr. Moss

CE 452—ADVANCED STRUCTURAL ANALYSIS—2 cr. (2 and 0)  
Mr. Trively

CE 501—ADVANCED STRUCTURAL ENGINEERING—3 cr. (2 and 3)  
Analysis of statistically indeterminate structures including secondary stresses and rigid frames.
CE 502—ADVANCED STRUCTURAL ENGINEERING—3 cr. (2 and 3)
A continuation of CE 501.

CE 503—MODEL ANALYSIS—3 cr. (2 and 3)
Methods of determining moments and stresses from a study of models: principles of similitude; use of the Beggs deformator. Prerequisites: Graduate standing and approval of instructor.

CE 510—HIGHWAY SAFETY AND TRAFFIC CONTROL—3 cr. or 2 cr. (3 and 0) or (2 and 0)
Study of highway safety principles affecting the design of city streets and rural highways, devices for controlling highway traffic and related subjects, and design of traffic signal systems. Prerequisite: CE 307.

CE 511—HIGHWAY DESIGN—3 cr. (2 and 3)
Studies of economics of highway grades, location, alignment with road surfaces, and factors that control highway planning. Prerequisite: CE 307.

CE 519—HIGHWAY RESEARCH—2 to 4 cr.
Independent investigation of some problems in highway engineering.

CE 520—CONCRETE MIXES AND MATERIALS—3 cr. (2 and 3)
Properties and factors controlling properties of concrete: investigation and selection of materials; mixes and design of mixes; inspection, field laboratory facilities and reports; concrete manufacture; handling, placing and curing; special types; sonic method of testing. Prerequisite: CE 409.

CE 531—SOIL ENGINEERING—3 cr. (2 and 3)
Shearing resistance consolidation, settlement, displacement and compaction, pile supporting strength, application of principles to earthwork, foundations and highway problems. Prerequisite: CE 414.

CE 591—RESEARCH—3 cr.
CE 592—RESEARCH—3 cr.

DAIRY

Dairy 306—MARKET MILK—3 cr. (3 and 0) Mr. Goodale
Dairy 309—ANIMAL NUTRITION—3 cr. (3 and 0) Mr. King
Dairy 352—ADVERTISING AND MARKETING—3 cr. (3 and 0) Mr. Goodale
Dairy 354—ENDOCRINOLOGY—3 cr. (3 and 0) Mr. Hurst
Dairy 401—DAIRY MANUFACTURES—3 cr. (2 and 3) Mr. Goodale
Dairy 402—DAIRY MANUFACTURES—4 cr. (2 and 6) Mr. Goodale
Dairy 405—DAIRY CATTLE BREEDING—3 cr. (2 and 3) Mr. LaMaster
Dairy 452—DAIRY CATTLE FEEDING AND MANAGEMENT—3 cr. (2 and 3) Mr. LaMaster
Dairy 501—TOPICAL PROBLEMS—1 to 3 cr.
Topics of interest to the graduate students. The course is designed to give experience with problems in dairying not covered by thesis research. Credit varies with the problem selected.

Dairy 502—GENETICS OF DAIRY CATTLE IMPROVEMENTS—3 cr.
(3 and 0)
A study of the inheritance in dairy cattle, with emphasis on milk and butterfat production, methods used in proving sires and dams and in analyzing herds as aids to selection. Mr. Brandt

Dairy 503—PHYSIOLOGY OF REPRODUCTION AND MILK SECRETION—3 cr. (3 and 0)
A study of the influence of the endocrine glands on reproduction and on milk secretion. Mr. Hurst

Dairy 505—NEWER KNOWLEDGE OF ANIMAL NUTRITION—3 cr.
(3 and 0)
The application of the latest information on digestion, metabolism, and the nutritional requirements of animals. Mr. King

Dairy 591—RESEARCH—3 cr.
Dairy 592—RESEARCH—3 cr.

DRAWING AND DESIGNING
DD 460—MECHANICAL VIBRATIONS—3 cr. (3 and 0) Mr. Shigley
DD 461—PHOTOELASTICITY—2 cr. (1 and 3) Mr. Shigley
DD 501—DESIGN PROBLEMS IN VIBRATIONS AND DYNAMICS—3 cr.
(3 and 0)
The application of vibration theory and dynamics to the design of machinery, critical speeds and inertia disturbances, equivalent systems, non-linear systems, isolators, damping devices, and vibration instruments. Prerequisite: Math 455 or approval of instructor. Mr. Shigley

ECONOMICS AND SOCIOLOGY
To be eligible to obtain graduate credit for one or more courses in Economics or Sociology the student must have earned at least twelve semester hours credit for undergraduate work in this field. The student will schedule courses in this field along with undergraduate students but will be expected to complete such additional assignments as the instructor may require.

Econ 412—INTERNATIONAL TRADE—3 cr. (3 and 0) Mr. Trevillian
Soc 403—CRIMINOLOGY—3 cr. (3 and 0) Mr. Burtner
Soc 405—INDUSTRIAL SOCIOLOGY—3 cr. (3 and 0) Mr. Burtner
Soc 406—REGIONAL SOCIOLOGY—3 cr. (3 and 0) Mr. Burtner
EDUCATION

Students desiring to pursue graduate work with a major in the field of Education are expected to have as prerequisite enough work in this field to qualify them for a Class III teachers certificate under the rules of the State Board of Education. Students desiring to minor in this field or to elect one or more courses for graduate credit must have the approval of the Head of the Department in which the work is offered and the Dean of the Graduate School. Students electing courses numbered less than 500 will schedule their work along with undergraduate students but will be expected to complete such additional assignments as the instructors may require.

Candidates for the Master's degree in the School of Education will select a major in Education, Industrial Education or Vocational Agricultural Education. Educ 591 is required for all candidates whose majors are to be in this school. In addition to this course each candidate will be expected to complete one additional course in research. A minor must be completed in some field outside of the School of Education.

Educ 401—METHODS IN AGRICULTURAL EDUCATION—3 cr. (3 and 0) Mr. Monroe
Educ 421—COORDINATION METHODS IN VOCATIONAL EDUCATION—2 cr. (2 and 0) Mr. Booker
Educ 422—PROBLEMS IN ADULT EDUCATION—3 cr. (3 and 0) Mr. Stribling
Educ 424—TECHNIQUE OF TEACHING—3 cr. (3 and 0) Mr. Brock
Educ 432—JOB ANALYSIS AND COURSE CONSTRUCTION—3 cr. (3 and 0) Mr. Booker
Educ 446—SHOP PLANNING AND LAYOUT—3 cr. (3 and 0) Mr. Booker
Educ 458—HEALTH EDUCATION—3 cr. (3 and 0) Mr. Gentry
Educ 460—CURRICULUM DEVELOPMENT, ELEMENTARY SCHOOLS—3 cr. (3 and 0)
Educ 494—SCHOOL AND COMMUNITY RELATIONSHIPS, ELEMENTARY SCHOOLS—3 cr. (3 and 0)
Educ 496—PUBLIC AND INDUSTRIAL RELATIONS FOR VOCATIONAL TEACHERS AND SUPERVISORS—3 cr. (3 and 0)
Educ 497—AUDIO-VISUAL AIDS IN THE ELEMENTARY SCHOOL—3 cr. (3 and 0) Mr. Brock
Educ 501—RECENT DEVELOPMENTS IN THE TECHNOLOGY OF AGRICULTURE—3 cr. (2 and 3)

This course will include a thorough analysis and appraisal of the experimental findings and successful farming practices developed during World War II and in the post war period in the various fields of agricul-
ture. It is designed to bring agricultural workers “up-to-date” in their knowledge and thinking in agricultural technology to the end that they may render more efficient service to rural people. Emphasis in this course will be on crops and mechanization.

Mr. Monroe

Educ 502—RECENT DEVELOPMENTS IN THE TECHNOLOGY OF AGRICULTURE—3 cr. (2 and 3)

A continuation of Educ 501 with emphasis in developments in animal sciences and agricultural economics.

Mr. Monroe

Educ 503—ADVANCED METHODS IN TEACHING—3 cr. (2 and 3)

The principles and practices involved in promoting effective learning will be developed in this course which is planned primarily for assisting experienced teachers who wish to improve their teaching procedures. Creating interest, inducing desired learning activities, causing intelligent use of what is learned, and measuring and evaluating results of teaching will be emphasized.

Mr. Stribling.

Educ 504—SPECIAL PROBLEMS IN TEACHING VOCATIONAL AGRICULTURE—3 cr. (2 and 3)

This course will be devoted to the analysis, exploration and development of plans for the solution of some of the current problems being encountered by teachers of Vocational Agriculture. Planning adequate programs of work, planning needed buildings, and equipment, securing and training assistant and/or special teachers, promoting cooperative efforts and similar problems will be chosen or assigned for individual and group effort.

Mr. Monroe

Educ 505—OCCUPATIONAL GUIDANCE AND PLACEMENT—3 cr. (3 and 0)

The organization and administration of a guidance program for schools of all sizes. A careful analysis is made of methods of interviewing students and counseling techniques involved in guidance. Data are collected on placement and follow-up work. A careful study is made of the needs for guidance in communities near the college.

Mr. Monroe

Educ 506—HISTORY AND PHILOSOPHY OF EDUCATION—3 cr. (3 and 0)

This course attempts to study the development of education over the different periods of civilization beginning with Athenian education and tracing the educational movements through the different periods of history with emphasis being placed upon the development of education in the United States. With each period studied attention is first directed to the central features of the social order, the dominant ideology, to the social structure, the classes of economic interest, and to the sources of political power and the formation of political institutions and social arrangements. Educational policies and practices and newer philosophy of American education are given detailed attention.

Mr. Booker

Educ 508—EDUCATIONAL MEASUREMENTS IN SECONDARY SCHOOLS—3 cr. (3 and 0)

A study of improved methods and techniques which may be used in the measurement of intelligence, specific aptitudes, and achievement. A
survey is made of standardized tests, the sources from which they may be secured and the purposes which they may serve in classification and/or instruction of students. Emphasis is given to the construction of informal tests of achievement, and to the administration and interpretation of standardized group tests. Practice is provided in the use of standardized group tests. The relationship of time and motion studies to industrial operations is considered.

Mr. Gentry

Educ 509—ANALYSIS OF THE INDIVIDUAL—3 cr. (3 and 0)

Emphasis is placed on the study and use of techniques of discovering the characteristics of individuals. Training experiences are provided in securing, recording, and interpreting significant data as they relate to counseling. Prerequisites: Eighteen semester credits in undergraduate and/or graduate professional education, or two years of experience in teaching.

Mr. Gentry

Educ 511—PUBLIC SCHOOL ADMINISTRATION (Finance)—3 cr.

(3 and 0)

Sound principles and suitable procedures relating to school administration and finance especially for the size school districts represented by the membership of the class.

Educ 513—EDUCATIONAL AND OCCUPATIONAL INFORMATION—3 cr.

(3 and 0)

An examination and evaluation is made of techniques for discovering, collecting, filing, interpreting, and using occupational information in counseling. Practice in the use of these techniques is emphasized. Making community surveys and follow-up studies are considered, as a means of securing pertinent information.

Mr. Monroe

Educ 515—ADVANCED METHODS OF TEACHING FARM MECHANICS—3 cr. (2 and 3)

Organization of teaching units, methods of determining the content of the course, securing and equipping the shop, teaching farm mechanics and other shop problems which are involved in teaching farm people are considered in this course. School shop management, planning lessons and demonstrations are also given major emphasis.

Mr. Monroe

Educ 516—HISTORY AND PHILOSOPHY OF VOCATIONAL EDUCATION—3 cr. (3 and 0)

A comprehensive course including the development of vocational education to present time. The influence of European vocational programs on the United States, the Federal Vocational Acts policies. Current problems and trends will be discussed.

Educ 517—AUDIO-VISUAL AIDS IN SECONDARY SCHOOLS—3 cr. (2 and 3)

This course will consider the use of audio and visual aids in a school program. Such phases as costs, securing and evaluating of machines, instruments, supplies, films, charts, maps, globes, will be considered. Sound recording, classroom intercom and radio units, and television will be
studied and evaluated for educational purposes. **Prerequisite:** Graduate standing, with teaching experience or at least three courses in Education, instructor's approval.

**Educ 518—ORGANIZATION AND ADMINISTRATION OF ELEMENTARY SCHOOL—3 cr. (3 and 0)**

This course is an approach to the organization of the elementary school in terms of improved situations for administrators, teachers, and students. It deals with the problems of "curriculum design and how that design may be put into practice" in terms of relating needs to those of modern society and the resultant implication for curriculum development. The course will contain a comprehensive discussion of the scope of the elementary principalship and the duties and responsibilities of the principal in improving education.

**Educ 520—TEACHING YOUNG FARMERS—3 cr. (3 and 0)**

The purpose of this course is to provide training for young farmers establishing themselves in the business of farming. Emphasis will be placed upon organization, cooperation and private enterprise. Buying and selling on various types of markets will be covered. The uses of governmental facilities for handling goods, credit, communications, and power will be studied. Conservation as a community and individual enterprise will be discussed. Limited number of field trips will be considered. How young farmers may cooperate with younger F.F.A., 4-H Club, and older farmers will be stressed.

**Educ 521—ADULT EDUCATION DEVELOPMENT AND ADMINISTRATION—3 cr. (3 and 0)**

A critical analysis of the adult education movement and its influence on trade and industrial workers; the applicability of education practices to industrial training problems; major fields of training in industry; evaluation of unions participation in education programs; psychological approaches to problems in worker-management relations.

**Educ 525—SUPERVISION OF STUDENT TEACHING—3 cr. (3 and 0)**

In this course major emphasis is placed upon the following: (1) developing a point of view or philosophy of teacher education; (2) analyzing the present teacher training program in South Carolina, to discover problem situations that may be used as a basis for teacher education programs; (3) determining the relative emphasis for each teacher to place upon the solution of the problems in the teacher-education program; (4) projecting plans for an apprentice training program, and (5) supervising apprentice training in the state.

**Educ 530—TECHNIQUES OF SUPERVISION—THE PUBLIC SCHOOLS—3 cr. (3 and 0)**

This course is designed for teachers, principals, and superintendents who are interested in improving, coordinating, and evaluating problems. Trends will be studied.
Educ 531—PUBLIC SCHOOL EVALUATION—3 cr. (3 and 0)

To determine the effectiveness of a school program it is important that its work be measured by the best available educational yardsticks. The regional accrediting agencies and other organizations have developed gauges and devices which are worthwhile instruments when used by competent educators. Total personal growth, subject matter progress, and physical facilities should all be evaluated in terms of desirable standards. Step by step development of total long term plans measured against community needs should be carefully evaluated. The objectives of this course include those mentioned above as well as problems presented by members of the class.  

Mr. Hawthorne

Educ 561—ADMINISTRATION AND SUPERVISION OF VOCATIONAL EDUCATION—3 cr. (3 and 0)

The expanding program of vocational education under the George-Barden Act and problems on national, state and local levels will be discussed. Major specific problems in unit trade programs, out-of-school youth, selection and training of teachers, veteran training and others will be covered.

Mr. Booker

Educ 591—INTRODUCTION TO RESEARCH IN EDUCATION—3 cr. (3 and 0)

The course attempts to familiarize the graduate student in education with the methods and techniques common to educational research, and to give training and experience in evaluating research in education. Studies and theses of various types will be examined and summarized.  

Mr. White

Educ 592—RESEARCH IN AGRICULTURAL EDUCATION—3 cr. (3 and 0)

A continuation of Educ 591. The student will conduct individual research on some problem in agricultural education. The student may submit a report on this research, which if acceptable to his examining committee will meet the thesis requirement.

Educ 594—RESEARCH IN EDUCATION—3 cr. (3 and 0)

A continuation of Educ 591. The student will conduct individual research on some problem in industrial education. The student may submit on this research, which if acceptable to his examining committee will meet the thesis requirement.

Educ 596—RESEARCH IN INDUSTRIAL EDUCATION—3 cr. (3 and 0)

A continuation of Educ 591. The student will conduct individual research on some problem in industrial education. The student may submit a report on this research which if acceptable to his examining committee will meet the thesis requirement.
ELECTRICAL ENGINEERING

EE 311—DIRECT-CURRENT MACHINERY—4 cr. (3 and 3)
EE 313—BASIC ELECTRICAL MEASUREMENT—3 cr. (2 and 3)
EE 315—ALTERNATING-CURRENT CIRCUITS—3 cr. (3 and 0)
EE 316—ALTERNATING-CURRENT CIRCUITS—4 cr. (3 and 3)
EE 320—ELECTRONICS—4 cr. (3 and 3)
EE 313—BASIC ELECTRICAL MEASUREMENT—3 cr. (2 and 3)
EE 315—ALTERNATING-CURRENT CIRCUITS—3 cr. (3 and 0)
EE 316—ALTERNATING-CURRENT CIRCUITS—4 cr. (3 and 3)
EE 405—ENGINEERING ANALYSIS—1 cr. (0 and 3)
EE 406—ENGINEERING ANALYSIS—1 cr. (0 and 3)
EE 411—ALTERNATING-CURRENT MACHINERY—5 cr. (3 and 6)
EE 412—ALTERNATING-CURRENT MACHINERY—4 cr. (3 and 3)
EE 415—ADVANCED CIRCUITS—3 cr. (3 and 0)
EE 422—ELECTRIC DISTRIBUTION—2 cr. (2 and 0)
EE 425—ELECTRIC TRANSIENTS—3 cr. (3 and 0)
EE 427—ADVANCED A. C. MACHINERY—3 cr. (3 and 0)
EE 431—RADIO COMMUNICATION—4 cr. (3 and 3)
EE 432—RADIO COMMUNICATION—4 cr. (3 and 3)
EE 434—INDUSTRIAL ELECTRONIC CONTROLS—3 cr. (2 and 3)
EE 436—RADIATION AND WAVE PROPAGATION—3 cr. (3 and 0)
EE 501—ADVANCED ELECTRIC TRANSIENTS—3 cr. (2 and 3)
A study of linear electrical systems using Layplace transformation to determine transient as well as steady state response. Emphasis will be placed on operational calculus to solve integral-differential equations of the system.

EE 511—ELECTRIC POWER STATIONS—3 cr. (3 and 0)
A comprehensive study of station lay-out, generating equipment, exciters, transformers, meters, switching and protective devices. Economical arrangement and operation are emphasized.

EE 513—POWER SYSTEM STABILITY—3 cr. (3 and 0)
A course designed to provide the student with the basic theory of both steady state stability and transient stability and their applications to system and apparatus design.

EE 514—POWER SYSTEM STABILITY—3 cr. (3 and 0)
A continuation of EE 513.

EE 520—ULTRA-HIGH FREQUENCY TECHNIQUES—4 cr. (3 and 3)
Applications of conventional tubes at high frequencies, characteristics of the magnetron and velocity modulated tubes. Cathode ray tubes and
circuits, applications of transmission lines, wave guides and cavity resonators. **Prerequisite:** EE 432 or the equivalent.

**EE 521—RADIATION AND WAVE PROPAGATION—3 cr. (3 and 0)**
An advanced study of electric fields, vector analysis, Maxwell's equations and their use in the study of wave guides, radiation and wave propagation.

**EE 591—RESEARCH—3 cr.**
**EE 592—RESEARCH—3 cr.**

**ENGLISH**

To be eligible to receive graduate credit for courses in English the student should have at least six semester hours undergraduate credit in English literature above the sophomore level. Graduate students will schedule courses with undergraduate students but will be expected to complete such additional assignments as the instructor may require.

**Engl 405—SHAKESPEARE—3 cr. (3 and 0)**
Mr. Taylor

**Engl 406—SHAKESPEARE—3 cr. (3 and 0)**
Mr. Taylor

**Engl 409—CHAUCER—3 cr. (3 and 0)**
Mr. Owings

**Engl 423—AMERICAN LITERATURE—3 cr. (3 and 0)**
Mr. C. B. Green, Mr. J. C. Green

**Engl 424—AMERICAN LITERATURE—3 cr. (3 and 0)**
Mr. C. B. Green, Mr. J. C. Green

**Engl 425—THE ROMANTIC REVIVAL—3 cr. (3 and 0)**

**Engl 426—THE ROMANTIC REVIVAL—3 cr. (3 and 0)**

**Engl 427—VICTORIAN LITERATURE—3 cr. (3 and 0)**
Mr. C. B. Green

**Engl 428—VICTORIAN LITERATURE—3 cr. (3 and 0)**
Mr. C. B. Green

**Eng 431—RESTORATION AND EIGHTEENTH CENTURY—3 cr. (3 and 0)**
Mr. MacIntosh

**ENTOMOLOGY**

**Ent 302—GENERAL ENTOMOLOGY—3 cr. (2 and 3)**
Mr. Dunavan

**Ent 401—ECONOMIC ENTOMOLOGY—3 cr. (2 and 3)**
Mr. Warnhoff

**Ent 402—ECONOMIC ENTOMOLOGY—3 cr. (2 and 3)**
Mr. Warnhoff

**Ent 405—INSECT MORPHOLOGY—3 cr. (2 and 3)**
Mr. Warnhoff
Ent 451—RESEARCH TECHNIQUES AND METHODS—2 cr. (1 and 3)  
Mr. Cochran

Ent 452—TAXONOMIC ENTOMOLOGY—2 cr. (1 and 3)  
Mr. Dunavan

Ent 456—PARASITOLOGY—3 cr. (2 and 3)  
Mr. Warnhoff

Ent 505—ADVANCED MORPHOLOGY—3 cr. (2 and 3)  
Prerequisites: Ent 405  
Mr. Warnhoff

Ent 552—ADVANCED SYSTEMATIC ENTOMOLOGY—2 cr. (0 and 6)  
Prerequisite: Ent 452.  
Mr. Dunavan

Ent 556—MEDICAL ENTOMOLOGY—3 cr. (2 and 3)  
Disease vectors of animals with emphasis on insects and related Arthropod disease carriers. Prerequisites: Ent 301.  
Mr. Goodwin

Ent 561—INSECT TOXICOLOGY—3 cr. (2 and 3)  
History, development, application, chemical nature and mode of action of insects. Prerequisites: Ag Ch 220 and Ent 405.  
Mr. Cochran

Ent 562—INSECT PHYSIOLOGY—3 cr. (2 and 3)  
The physiology of nutrition, digestion, respiration, excretion, nervous and hormonal systems. Prerequisites: Ag Ch 220 and Ent 405  
Mr. Chamberlian

Ent 591—RESEARCH—3 cr.

Ent 592—RESEARCH—3 cr.

HISTORY AND GOVERNMENT

To be eligible to obtain graduate credit for courses in History and Government the student should have earned at least twelve semester hours of undergraduate work in this field. The student will schedule the course along with undergraduate students but will be expected to complete such additional assignments as the instructor may require.

Gov 401—COMPARATIVE GOVERNMENT—3 cr. (3 and 0)  
Mr. Bolen

Hist 308—EUROPE SINCE 1918—3 cr. (3 and 0)  
Mr. Bolen

Hist 401—HISTORY OF SOUTH CAROLINA—3 cr. (3 and 0)  
Mr. Epting

Hist 403—HISTORY OF THE SOUTH TO 1865—3 cr. (3 and 0)  
Mr. Williams

Hist 404—HISTORY OF THE SOUTH SINCE 1865—3 cr. (3 and 0)  
Mr. Lander

Hist 405—THE AMERICAN FRONTIER—3 cr. (3 and 0)  
Mr. Williams
HORTICULTURE

Hort 301—PRINCIPLES OF VEGETABLE PRODUCTION—3 cr. (2 and 3)  Mr. Thode
Hort 306, 308—ELEMENTARY LANDSCAPE DESIGN—3 cr. (2 and 3)  Mr. Thode
Hort 401, 403—LANDSCAPE DESIGN—3 cr. (2 and 3)  Mr. Thode
Hort 402, 404—GARDEN DESIGN—3 cr. (2 and 3)  Mr. Thode
Hort 405—NUT CULTURE AND SPRAYS—3 cr. (2 and 3)  Mr. Sefick
Hort 415—FLORICULTURE—3 cr. (2 and 3)  Mr. Thode
Hort 451—SYSTEMATIC POMOLOGY AND SMALL FRUIT CULTURE—3 cr. (2 and 3)  Mr. Musser
Hort 452—COMMERCIAL POMOLOGY—3 cr. (2 and 3)  Mr. Musser
Hort 455—BREEDING HORTICULTURAL CROPS—3 cr. (2 and 3)  Mr. Senn
Hort 456—TRUCK CROPS—3 cr. (2 and 3)  Mr. Garrison
Hort 460—ADVANCED LANDSCAPE DESIGN—3 cr. (2 and 3)  Mr. Thode
Hort 464—FOOD PRESERVATION—3 cr. (2 and 3)  Mr. Van Blaricom
Hort 466—RESEARCH METHODS—3 cr. (2 and 3)  Mr. Senn
Hort 501—PROBLEMS IN SMALL FRUIT PRODUCTION—3 cr. (2 and 3)  Mr. Sefick

This course involves a study of selected problems encountered in the production of blueberries, strawberries, brambles and grapes. Prerequisite: Hort 451.

Hort 503—ADVANCED VEGETABLE CROPS—3 cr. (3 and 0)  Mr. Garrison

This course involves a systematic study of sources of information and practices with emphasis on the application and handling of vegetable crops. Prerequisite: Hort 456.

Hort 505—FOOD TECHNOLOGY—3 cr. (1 and 6)  Mr. Van Blaricom

The course includes quality control methods and equipment such as special titrations, taste panels, refractometers, succulometers, tenderometers, and colorimeters; the role of sugars, salts, acids, and chemical preservatives in foods; quality grade standards, and special problems. Prerequisites: Bact 301, 303, Hort 464.

Hort 507—ADVANCED POMOLOGY—3 cr. (2 and 3)  Mr. Musser

A study of the growth and development of deciduous fruits with most emphasis on the peach and apple. Prerequisite: Hort 452.

Hort 591—RESEARCH—3 cr.
Hort 592—RESEARCH—3 cr.
In En 402—METALLURGY—3 cr. (2 and 3)  Mr. Freeman

**MATHEMATICS**

Math 302—THEORY OF EQUATIONS—3 cr. (3 and 0)  Mr. Armstrong
Math 303—STATISTICS—3 cr. (3 and 0)  Mr. Sullivan
Math 304—STATISTICS—3 cr. (3 and 0)  Mr. Sullivan
Math 306—ORDINARY DIFFERENTIAL EQUATIONS—3 cr. (3 and 0)  Mr. Miller, Mr. Brewster

Math 307—ELEMENTARY PARTIAL DIFFERENTIAL EQUATIONS—3 cr. (3 and 0)  Mr. Kelly
Math 451—VECTOR ANALYSIS—3 cr. (3 and 0)  Mr. Miller
Math 453—ADVANCED CALCULUS—3 cr. (3 and 0)  Mr. Coker
Math 454—ADVANCED CALCULUS—3 cr. (3 and 0)  Mr. Coker
Math 501—PARTIAL DIFFERENTIAL EQUATIONS—3 cr. (3 and 0)
   This course contains analysis theory which has wide application in applied mathematics and the allied fields of physics, engineering, and chemistry. The topics include orthogonal functions, Fourier series, Bessel functions, Legendre polynomials, Strum-Liouville systems, etc.  Mr. Kelly

Math 502—DETERMINANTS AND MATRICES—3 cr. (3 and 0)
   This course should be of benefit to students who plan to do further graduate work in mathematics, engineering or physics. Some of the topics included in the course are determinants, polynomials and forms, transformations, system of linear equations.  Mr. Hind

Math 503—THEORY OF FUNCTIONS OF COMPLEX VARIABLES—3 cr. (3 and 0)
   This is a basic course in analysis which has wide application in applied mathematics and allied fields. This course should be of interest primarily to mathematics and physics majors and possibly to engineering majors if they plan further study. The topics in the course include differentiation and integration of analytic functions, power series, residues, contour integration, analytic continuation, and conformal mapping.  Mr. Brewster

Math 504—THEORY OF FUNCTIONS OF COMPLEX VARIABLES —3 cr. (3 and 0)
   A continuation of Math 503.  Mr. Brewster
Math 591—RESEARCH—3 cr.
Math 592—RESEARCH—3 cr.
MECHANICAL ENGINEERING

ME 311—ENGINEERING THERMODYNAMICS—3 cr. (3 and 0)
Mr. Watson, Mr. Edwards

ME 312—ENGINEERING THERMODYNAMICS—3 cr. (3 and 0)

ME 411—HEAT POWER—3 cr. (3 and 0)
Mr. Fernow

ME 412—HEAT POWER—3 cr. (3 and 0)
Mr. Fernow

ME 413—HEAT POWER LABORATORY—2 cr. (0 and 6)
Mr. Sutton

ME 414—HEAT POWER LABORATORY—2 cr. (0 and 6)
Mr. Watson

ME 417—MECHANICAL DESIGN—2 cr. (1 and 3)
Mr. Lewis

ME 421—GAS ENGINES—3 cr. (3 and 0)
Mr. Lewis

ME 423—GAS ENGINE DESIGN—1 cr. (0 and 3)
Mr. Lewis

ME 429—HEATING AND VENTILATION—2 cr. (2 and 0)
Mr. Hudson

ME 430—AIR CONDITIONING—2 cr. (2 and 0)
Mr. Watson

ME 431—HEATING AND VENTILATION DESIGN—1 cr. (0 and 3)
Mr. Watson

ME 432—AIR CONDITIONING DESIGN—1 cr. (0 and 3)
Mr. Watson

ME 434—REFRIGERATION—2 cr. (2 and 0)
Mr. Fernow

ME 438—FUELS AND COMBUSTION—2 cr. (2 and 0)
Mr. Edwards

ME 461—ANALYSIS OF THERMODYNAMIC PROBLEMS—3 cr. (3 and 0)

ME 464—HEAT TRANSMISSION—3 cr. (3 and 0)
Mr. Watson

ME 501—ADVANCED AIR CONDITIONING—3 cr. (3 and 0)
An analysis of the principles of air conditioning. The following topics are among those covered; enthalphy of air-vapor mixtures; adiabatic mixtures of air with water, steam or ice; fogged air; adiabatic saturation; air in contact with water; fundamental simultaneous and fundamental successive conditioning processes; humid air below 32 degrees F.; geometry of the psychrometric chart. A critical analysis of current literature on special topics. Prerequisites: ME 429, 430, 431, and 432.

ME 510—ADVANCED THERMODYNAMICS—3 cr. (3 and 0)
This course supplements and extends the material covered in elementary thermodynamics. Special topics relative to advanced problems in engineering are pursued. Prerequisites: ME 311, 312, 411, 412, and registration in Math 306.

ME 521—INTERNAL COMBUSTION ENGINES—3 cr. (3 and 0)
Internal combustion process analysis, deviation from the ideal processes, detonation, and knock testing, carburetion and fuel injection, combustion chamber and cylinder head design, engine cooling, mechanics of principle moving parts, engine vibration and balance and engine design.

Mr. Lewis
ME 522—INTERNAL COMBUSTION ENGINES—3 cr. (3 and 0)
A continuation of ME 521. Mr. Lewis

ME 523—INTERNAL COMBUSTION ENGINE LABORATORY—1 cr.
(0 and 3)
Analysis of engine instrumentation, airfuel ratio tests, detonation limited power test, injection and analysis with test apparatus, fuels testing and general test codes. Mr. Lewis

ME 524—GAS TURBINES—3 cr. (3 and 0)
Gas turbine process analysis, deviation from the ideal process, fuels stratification, efficiencies, pressure ratio, including the development of charts for cycle analysis. Mr. Lewis

ME 532—APPLIED HEAT TRANSFER—3 cr. (3 and 0)
The application of heat transfer to several engineering problems pertaining to the design of heat transfer equipment such as boilers, condensers, evaporators, and air preheaters. Prerequisites: ME 312, 411, 412 and registration in Math 306. Mr. Watson

ME 591—RESEARCH—3 cr.

ME 592—RESEARCH—3 cr.

MECHANICS AND HYDRAULICS
Mech 401—FLUID MECHANICS—3 cr. (3 and 0)

Mech 403—FLUID MECHANICS LABORATORY—1 cr. (0 and 3)

Mech 460—HYDROLOGY—2 or 3 cr. (2 or 3 and 0)

Mech 462—WATER POWER ENGINEERING—2 or 3 cr. (2 or 3 and 0)

Mech 464—FLOW IN OPEN CHANNELS—2 or 3 cr. (2 or 3 and 0)

Mech 502—SPECIAL TOPICS IN MECHANICS OF MATERIALS—3 cr.
(3 and 0)
A study of the general state of stress, strain-energy methods, theories of failure, indeterminate problems in bending, curved bars, dynamic stresses, plates and problems of elastic stability. Prerequisites: Mech 304 and graduate standing. Mr. Byars

Mech 504—DYNAMICS—3 cr. (3 and 0)
A development of more advanced methods of analysis of problems in dynamics with emphasis on practical solutions. Topics are systems with variable mass and variable forces, shaking forces, balancing, vibration, gyroscopes and models. Prerequisites: Mech 303 and graduate standing. Mr. Nowack
Mech 506—FLUID MECHANICS II—3 cr. (3 and 0)
A comprehensive study of the principles of fluid flow and the application of the principles to practical engineering problems. Among the topics considered are fluid velocity and acceleration, significance of the flow net, pressure distributions, viscosity, surface tension, compressibility, boundary layer and circulation and magnus effect. Prerequisites: Mech 401 and graduate standing. Mr. Humphreys, Mr. Moorman

Mech 508—FLOOD CONTROL—3 cr. (3 and 0)
A study of the hydrology of floods and the engineering considerations relating to their control. Topics considered in the scope of control measures are economic justification, types of control structures, and survey of flood control measures on major streams in the U. S. Prerequisites: Mech 460 and graduate standing.

Mech 510—ADVANCED HYDROLOGY—2 cr. (2 and 0)
Special work to strengthen the student’s background in modern methods. The technical literature is used extensively for the latest developments. Emphasis is laid on evaporation, infiltration and the synthetic hydrograph. Prerequisites: Mech 460 and graduate standing. Mr. Curtis

Mech 512—HYDRAULIC PROJECTS—3 cr. (3 and 0)
This course is devoted to the detailed investigation of engineering problems in hydraulics and related fields. Application of theoretical principles developed in previous courses is emphasized. Subjects include: Spillway and stilling basin; reservoirs; inverted siphons. Prerequisites: Mech 460, 464; must be accompanied or preceded by Mech 506.

Mech 591—RESEARCH—3 cr.
Mech 592—RESEARCH—3 cr.

PHYSICS
Graduate students majoring in Physics are normally expected to take at least two of the following three courses as a part of their graduate program; Physics 521, 541 and 542. Students majoring in this field are required to demonstrate a reading knowledge of one modern foreign language. It is suggested that these students select a minor in Mathematics, Chemistry or one of the branches of Engineering.

Phys 312—HEAT AND KINETIC THEORY—3 cr. (3 and 0) Mr. Lindsey
Phys 314—EXPERIMENTAL HEAT—1 cr. (0 and 3) Mr. Lindsey
Phys 321—MECHANICS AND PROPERTIES OF MATTER—4 cr. (4 and 0) Mr Huff
Phys 323—EXPERIMENTAL MECHANICS—1 cr. (0 and 3) Mr. C. A. Reed
Phys 341—ELECTRICITY AND MAGNETISM—3 cr. (3 and 0)
Phys 343—ELECTRICITY LABORATORY—1 cr. (0 and 3)  
Phys 432—LIGHT—4 cr. (4 and 0)  
Phys 434—EXPERIMENTAL LIGHT—1 cr. (0 and 3)  
Phys 441—ELECTROMAGNETISM—3 cr. (3 and 0)  
Phys 451—MODERN PHYSICS—3 cr. (3 and 0)  
Phys 452—ATOMIC AND NUCLEAR PHYSICS—3 cr. (3 and 0)  
Phys 471—ELECTRON MICROSCOPY—3 cr. (2 and 3)  
Phys 511—THERMODYNAMICS—3 cr. (3 and 0)  
  A study of the laws of the thermodynamics entropy and properties of pure substance, engine cycles, the applications of thermodynamics to various systems and applications to chemical systems.  
  Mr. Miller  
Phys 512—KINETIC THEORY AND STATISTICAL MECHANICS—3 cr. (3 and 0)  
  A development of the kinetic theory of gases including derivations of relationships between molecular diameters, distribution of velocities, mean free paths, viscosity, thermal conductivity, specific heat, entropy, probability and reaction kinetics. The basic concepts of statistical mechanics for classical and quantum systems will be developed.  
  Mr. Lindsey  
Phys 521—DYNAMICS—3 cr. (3 and 0)  
  A study of the more advanced phase of dynamics including the equations of LaGrange and Hamilton, generalized coordinates, oscillatory and cyclic motion and Newtonian potential theory.  
  Mr. Crawford  
Phys 541—ELECTRODYNAMICS—3 cr. (3 and 0)  
  This course starts with Maxwell’s equations for electric and magnetic fields and includes consideration of production and propagation of electromagnetic waves, wave optics and theories of interference and diffraction.  
  Mr. C. A. Reed  
Phys 542—RADIATION THEORY—3 cr. (3 and 0)  
  The production and propagation of electromagnetic waves are studied using Maxwell’s equations as a starting point. Discussion of wave guides, diffraction phenomenon, and boundary effects are included. An introduction to the theory of electrons and microscopic phenomenon will be given.  
  Mr. Crawford  
Phys 551—INTRODUCTION TO QUANTUM MECHANICS—3 cr. (3 and 0)  
  An introductory course formulating the mathematical physical ideas associated with wave mechanics. Solution of simple physical systems including the hydrogen atom are discussed. Prerequisites: Phys 301 and Math 306.  
  Mr. Huff
Phys 552—THEORY OF ATOMIC SPECTRA—3 cr. (3 and 0)
A study of the excitation of spectra, computation of wave lengths from spectral photographs, the computation of energy levels and the correlation with theories of atomic structure. Mr. Huff

Phys 553—NUCLEONICS—3 cr. (3 and 0)
This course is designed to give the basic properties of and the experimental methods employed in the study of particles associated with the nucleus. A survey is made of the theories so far advanced for the interaction of these particles and the theories pertaining to the structure of simple nuclei. Mr. Huff

Phys 566—RELATIVITY—3 cr. (3 and 0)
This course is intended to give a survey of the special and general theory of relativity including tensor calculus, the Lorentz transformation and the three experimental tests of the general theory: (1) planetary motion and the advance of the perihelion of Mercury (2) the bending of light rays in gravitational field and (3) the gravitational shift of spectral lines.

Phys 575—SEMINAR IN CONTEMPORARY PHYSICS—1 or 2 cr. (1 or 2 and 0)
A joint study by graduate students and interested members of the faculty of some area of physics which is currently being extensively investigated.

Phys 591—RESEARCH—3 cr.
Phys 592—RESEARCH—3 cr.

POULTRY

PH 451—POULTRY BREEDING—3 cr. (2 and 3) Mr. Morgan
PH 452—POULTRY FEEDING AND FLOCK MANAGEMENT—3 cr. (2 and 3) Mr. Morgan
PH 455—POULTRY GRADING AND PROCESSING—3 cr. (2 and 3) Mr. Cooper
PH 456—INCUBATION AND BROODING—3 cr. (2 and 3) Mr. Cooper
PH 459—POULTRY DISEASES AND PARASITES—3 cr. (2 and 3) Mr. Morgan
PH 460—SEMINAR—2 cr. (2 and 0)
RURAL SOCIOLOGY

RS 454—FARMERS' MOVEMENT—3 cr. (3 and 0)  Mr. Boyd
RS 459—THE RURAL COMMUNITY—3 cr. (3 and 0)  Mr. Boyd
RS 461—RURAL LEADERSHIP—3 cr. (3 and 0)  Mr. Boyd
RS 501—RURAL SOCIAL SYSTEMS—3 cr. (3 and 0)

A course designed to provide the advanced student with a brief review of the basic working concepts of rural sociology and a knowledge of the basic institutions of rural life and to acquaint the student with the techniques used in applying scientific methods and theory toward understanding the social structure of rural life. Prerequisite: Permission of the instructor and 12 hours of social studies, at least three hours of which must be in the field of sociology.

Mr. Boyd

TEXTILE CHEMISTRY

TC 410—COLOR MATCHING AND TESTING—1 cr. (0 and 3)  Mr. Lindsay
TC 447—THE CHEMICAL PROCESSING OF TEXTILE MATERIALS—3 cr. (3 and 0)  Mr. Lindsay
TC 449—TEXTILE CHEMISTRY LABORATORY—1 cr. (0 and 3)  Mr. Lindsay
TC 452—THE CHEMICAL PROCESSING OF TEXTILE MATERIALS—4 cr. (4 and 0)  Mr. Lindsay
TC 454—TEXTILE CHEMISTRY LABORATORY—1 cr. (0 and 3)  Mr. Lindsay
TC 455—CELLULOSE CHEMISTRY—3 cr. (3 and 0)  Mr. Langston
TC 456—CHEMISTRY OF SYNTHETIC FIBERS AND FINISHES—3 cr. (3 and 0)  Mr. Langston
TC 511—THE THEORY AND APPLICATION OF SYNTHETIC RESINOUS MATERIALS—3 cr. (2 and 3)  Mr. Langston

The aim of the course is to give the student a comprehensive survey of the history, present utility, and probable future expansion of synthetic resins. Prerequisite: TC 306 or Chem 222.  Mr. Langston
TC 512—THE THEORY AND APPLICATION OF SYNTHETIC RESINOUS MATERIALS—3 cr. (2 and 3)  Mr. Langston

A continuation of TC 511.

TC 521—ADVANCED CELLULOSE CHEMISTRY—3 cr. (3 and 0)

The purpose of the course is to present the chemistry of cellulose and closely related polysaccharides, through a systematic study of the extensive volume of research which has been completed on these substances. Prerequisite: TC 306 or Chem 222.  Mr. Langston
TC 531—CHEMISTRY OF COLORING MATTERS—3 cr. (2 and 3)

The work of this course consists of an advanced study of coloring bodies in their major forms, as dyes, pigments and lakes. Their structure and formulation for use is covered in detail with the chief emphasis being placed on the more complex forms, such as the vat colors and insoluble azo compounds. **Prerequisite:** TC 452. Mr. Rainey

TC 591—RESEARCH—3 cr.

TC 592—RESEARCH—3 cr.

**TEXTILE MANAGEMENT**

TM 403—TEXTILE MANAGEMENT—3 cr. (3 and 0) Mr. Richardson

TM 460—NATURAL FIBERS—3 cr. (3 and 0) Mr. Heyn

TM 462—TEXTILE MICROSCOPY—2 cr. (1 and 3)

TM 464—PHYSICAL TEXTILE TESTING—2 cr. (1 and 3) Mr. Brown, Mr. Wray

**ZOOLOGY**

Zool 301—ADVANCED ZOOLOGY—3 cr. (2 and 3) Mr. Ware

Zool 302—VERTEBRATE EMBRYOLOGY—3 cr. (2 and 3) Mr. Ware

Zool 402—ANIMAL ANATOMY AND PHYSIOLOGY—3 cr. (2 and 3) Mr. Anderson

Zool 403—PROTOZOOLOGY—3 cr. ((2 and 3) Mr. Anderson

Zool 501—ADVANCED ANIMAL HISTOLOGY—3 cr. (2 and 3) Mr. Anderson

This is an advanced study in the microscopic structures of the tissues and organs of the animal body and the relation of histology to physiology and pathology. **Prerequisites:** Zool 101, 103, and 402. Mr. Anderson

Zool 502—HISTOLOGICAL TECHNIQUES—3 cr. (1 and 6) Mr. Ware

The fixing, staining, sectioning, and identification of all tissues, glands and organs of animals. **Prerequisites:** Zool 101, 103. Mr. Ware

Zool 503—ANIMAL ECOLOGY—4 cr. (2 and 6) Mr. Ware

A comprehensive study of animals in relation to their natural environment. Typical animal habitats are visited to study the animal life and the ocean, shore, lakes, streams, swamps, cultivated fields, woodlands, and mountains.
Zool 504—ORNITHOLOGY—3 cr. (2 and 3)
The identification, life history and ecology of birds. Field trips, work
with bird specimens and correlated reading will give the student a work-
ing knowledge of at least 100 species of the common birds. Mr. Ware

Zool 505—PATHOGENIC DISEASES OF LIVESTOCK—3 cr. (3 and 0)
A graduate course designed to acquaint the student with the cause,
prevention, and treatment of pathogenic diseases. Mr. Anderson

Zool 556—ECONOMIC ZOOLOGY—3 cr. (2 and 3)
A study of all phylla (exclusive of class insecta) to include those ani-
imals either beneficial or destructive to man. Prerequisites: Zool 101, 103.
Mr. Ware

Zool 591—RESEARCH—3 cr.

Zool 592—RESEARCH—3 cr.